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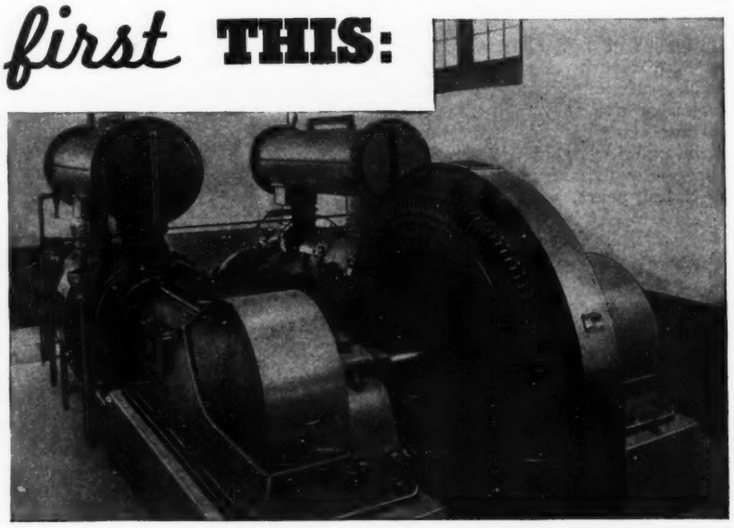

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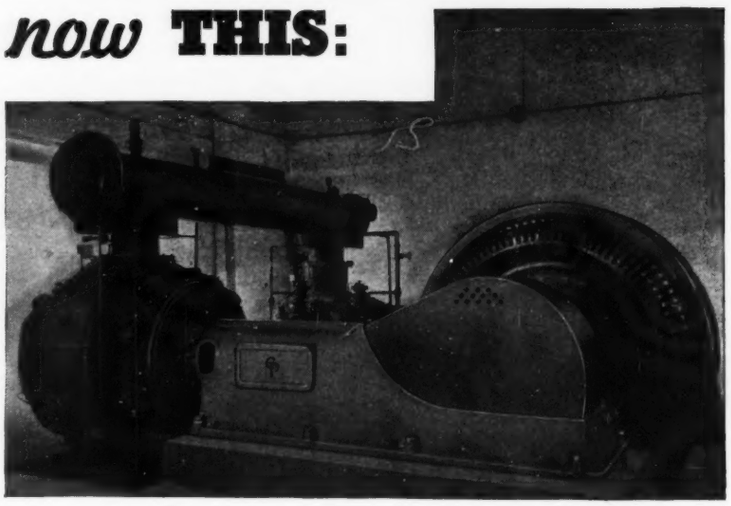

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MINING OUTLOOK

MEASURED BY ANY YARDSTICK the mining industry made substantial progress toward recovery in 1935 and now enjoys a more favorable prospect than at any time in the past few years. Barring unforeseen events, the prosperity that has prevailed in gold and silver mining should extend this year to the major non-ferrous metals.

● FOR THE FOURTH CONSECUTIVE YEAR world gold production showed an increase, and the 1935 output surpassed all previous records. Only excessive taxation to the point of diminishing returns is likely to stop the trend. Silver sailed serenely almost through the year, but toward the close nearly foundered on the rocks of international politics and finance. Domestic producers are still secure, but the year opens with the rest of the silver world in a state of apprehension and uncertainty.

● THE MAJOR NON-FERROUS METALS are in a favorable position for 1936, due largely to good management in 1935 that resulted in reduction of stocks to the accompaniment of increased consumption and higher prices. Potential demand is good. Electric energy consumption in the United States is at its peak, and the utilities must make heavy purchases of copper and other metals once their political shackles are broken. The automotive industry bids fair to continue its expansion, creating an increasing demand for copper, lead, and zinc. These metals will flow also into construction and agriculture as prosperity returns to those fields of activity. Consumption of nickel again surpassed previous records. The vagaries of the tin market revealed the inherent weaknesses of artificial control prevailing in that industry.

● INCREASING ATTENTION is being paid to the international aspects of the mineral industry. For this reason we publish a series of unique charts showing world production, consumption, and principal trade relations for ten major mineral products. Data for 1932 were selected as a basis for these charts because they represent the minimum non-deferable consumption of the products throughout the world. General relationships hold true for subsequent years. The charts are published through the courtesy of the Bureau of Foreign and Domestic Commerce and the Bureau of Mines. They were prepared in those Bureaus under the direction of J. W. Furness, chief, Economics Branch, United States Bureau of Mines, using in part funds made available by the National Resources Board, Charles W. Eliot II, Executive Officer.

● AN ATTEMPT HAS BEEN MADE in the following pages to give the reader a fair view of the current economic and technical aspects of the mining industry throughout the world.

GOLD

World's production increased 13 per cent during 1935 — Gain a spur to business recovery

H. N. Lawrie[1]
Consulting Economist

A NEW RECORD world's gold production for the fourth consecutive year was established in 1935, amounting to 31,600,000 fine ounces, as compared to 27,980,918 oz. in 1934, an increase of 3,619,082 oz., or 13 per cent, and more than a million ounces greater than the increase for the previous year. Table I, comparing the outputs in 1934 and 1935, records the fact that increases were general throughout the world and that the most important took place in Russia and Siberia, the United States, Canada, the Transvaal, and Mexico. To the total increase in the world's 1935 output, the U.S.S.R. alone contributed nearly 60 per cent. Declines in production were minor and few.

Production of gold in the United States in 1935 amounted to 3,115,450 oz., and including the Philippines and Puerto Rico to 3,546,169 oz., an increase of 463,635 oz. over the production of 1934, or 15 per cent higher than the increased ratio of world output by 2 per cent. California maintains its position as first in the production of gold in 1935; South Dakota replaces Alaska, which is now third; and Utah surpasses Nevada. The increases were general and reflect the more favorable prices for copper, lead, and zinc, as well as the high prices for gold and silver. The major increases were in California, 147,000 oz.; South Dakota, 87,473 oz.; Arizona, 73,687 oz., and in Utah, 43,106 oz.; the largest decline was in Alaska, 87,057 oz. Table II, comparing the outputs in the United States in 1934 and 1935, shows that the production of the Philippines increased 90,339 oz.

An immutable fundamental law governs the economic tides of the world as surely as a basic law controls the ocean tides. Repeatedly, economic crises of the past have been overcome by the restoration of normally functioning economic forces in response to the fundamental law; and in this connection one of the most important factors in world recovery has been an increasing production of new gold to supply the basis for increasing currency and credit. In the past the world production of gold has been to a large extent free to respond to the law of supply and demand, whereas during the progress of this the greatest of all economic crises with which the world has ever been confronted, the gold-mining industry has been and is now being subjected to the artificial restraint of burdensome taxation. Applied in varying degrees of intensity in different gold-producing countries, this burden of taxation has undoubtedly operated to restrict world production.

Since 1932, the first of the four successive world record gold productions, the declines in South African output and the static level of the outputs of Canada and New Zealand, while the output of the rest of the world was rapidly increasing, are ample evidence of where the pressure of taxation has borne down the heaviest. The actual production of gold in the world in 1933, 1934, and 1935 is, therefore, not a true index to the progress of world economic recovery. Had the gold-mining industry throughout the world been nominally free from taxation, as it should have been, considering the great importance of gold to the conduct of the world's business and the restoration of normal industry and trade, the world's gold output would have been considerably larger. If the heavy taxes on gold-mining profits and dividends, and on gold exports, had not been levied, it would be reasonable to expect that the world's output in 1933 would have been greater than it was by a million ounces, in 1934 by 1½ million ounces, and in 1935 by 2½ million ounces. With these increases assumed and the production of 1932 taken as a basis with an index number of 100, the table on the bottom of page 55 shows the comparative index numbers for the subsequent years.

Even though some may consider that the problematical increases which have been assumed in computing the indices of world gold production in the last column are low, nevertheless these indices reflect far more accurately than indices of actual gold production the progress of world economic recovery.

World economic recovery has so far advanced that were it not for the threat of war which has undermined public confidence and elevated matters of political consideration over those of economic concern, it would now be possible to consolidate the gains and estab-

Table I
WORLD PRODUCTION OF GOLD*
In Fine Ounces

	1934	1935
North America		
United States	2,742,161	3,116,000
Canada	2,969,680	3,260,000
Mexico	661,405	774,000
Newfoundland	12,000	12,000
Totals	6,385,246	7,162,000
Central America	130,000	150,000
South America	1,120,517	1,320,000
Europe		
Russia (and Siberia)	(*a*)4,312,770	(*b*)6,240,000
Other Europe	573,857	770,000
Totals	4,886,627	7,010,000
Asia		
British India	322,193	326,000
East Indies	66,295	60,000
Japan and Chosen (Korea)	841,385	871,000
Philippines	340,316	431,000
China and others	290,872	285,000
Totals	1,861,061	1,973,000
Oceania		
Australia	870,678	866,000
Fiji	1,833	2,000
Tasmania	5,622	5,000
New Guinea	211,099	255,000
Papua	7,438	7,000
New Zealand	160,248	160,000
Totals	1,256,918	1,295,000
Africa		
Transvaal	10,479,857	10,750,000
Rhodesia	693,265	710,000
West Africa	384,268	400,000
Congo, Egypt, etc	783,159	830,000
Totals	12,340,549	12,690,000
Totals for world	27,980,918	31,600,000
Total value in 1934 ($35 = 1 oz.)	$979,332,130	
Total value in 1935 ($35 = 1 oz.)	$1,106,000,000	

*Data for 1934 revised to date and 1935 estimates, based largely on ten months' actual production, by H. N. Lawrie.
(*a*) Contains 50,000 oz. recovered from gold-bearing material shipped to the United States for refining.
(*b*) Contains 526,000 oz. recovered from gold-bearing material shipped to the United States for refining.

[1]Formerly Economic Adviser to the United States Senate Commission of Gold and Silver Inquiry and author of the Gold and Silver chapter of "The Mineral Industry" since 1928.

Table II—Production of Gold in the United States*

(In Fine Ounces)

	1934	1935
Alaska.....	541,283	454,226
Alabama.....	2,951	1,965
Arizona.....	145,234	218,921
California.....	709,963	857,363
Colorado.....	321,740	348,914
Georgia.....	900	1,004
Idaho.....	88,729	81,264
Michigan.....	49	000
Montana.....	95,577	134,501
Nevada.....	142,494	165,812
New Mexico....	26,720	31,085
North Carolina.	666	2,175
Oregon.....	32,580	51,255
Pennsylvania...	557	845
South Carolina.	223	703
South Dakota..	481,749	569,222
Tennessee.....	531	623
Texas.....	303	493
Utah.....	137,943	181,049
Virginia.....	529	150
Washington....	6,714	10,091
Wyoming.....	4,726	3,789
Totals.....	2,742,161	3,115,450
Philippines.....	340,316	430,655
Puerto Rico....	57	64
Totals.....	3,082,534	3,546,169
Value.....	$107,888,690	(a)$124,115,915
Record Year, 1915..		4,887,604 oz.
Value.....		(b)$101,035,700

*Compiled by H. N. Lawrie from data issued by the Bureau of the Mint, with the cooperation of the Bureau of Mines.

(a) Value on the basis of $35 per fine ounce of gold.

(b) Value on the basis of $20.6718 per fine ounce of gold.

lish a solid foundation for the conduct of future normal business and trade. One of the most needed steps to be taken would be the readoption of the gold standard in some more modern form which would again serve the universal needs of the world with a largely automatically controlled monetary system, a sound foundation for credit and a stability in the foreign exchanges—all of which would enable the world to advance to standards of living and a level of economic freedom and independence such as never before has been possible of attainment.

Because of the present state of mind and political uncertainty in the world, and the fact that statesmen are compelled to concentrate on the maintenance of peace, it would be neither practicable nor desirable to attempt the adoption of the gold standard and the *de jure* stabilization of the exchanges which would result. However, world economic recovery has advanced far enough to permit the successful consideration by Great Britain, France, and the United States of a proposal to establish tentatively some definite ratio between the pound, franc, and dollar. Such a *de facto* stabilization would constitute a strong foundation upon which could be built gradually the world's future monetary system, as other nations would find it possible to join the group. World confidence would be restored in large measure, arbitrary trade restrictions would be either modified or removed, and the resulting stability in the currencies of these three great nations would soon be felt, and foreign trade throughout the world would be set free to make normal expansion. And the resumption of normal foreign trade and commerce is one of the most dependable safeguards of the maintenance of world peace.

New and important discoveries of gold deposits have been made. The application of geophysical methods has proved of great assistance in delimiting orebodies that lie altogether underground. In this way large areas underlain by the extension of the Rand gold-bearing reef have been discovered, and subsequent drilling has added them to the probable gold reserves of South Africa. With more improved mining and milling practice, old mines and placer deposits are being opened and reworked. Air-conditioning applied to the deep deposits of the Transvaal has made it possible to exploit ore which formerly had not been considered of commercial grade. And progress in the devolpment of the gold-mining industry throughout the world has been greatly expedited and assisted by the airplane. *Engineering and Mining Journal* for November, 1935, was devoted to the use of aviation in the mining industry, and much valuable information was made available.

	Actual World Production		Probable World Production	
	(1,000 Oz.)	Index Number	(1,000 Oz.)	Index Number
1932...	24,151	100.0	24,151	100.0
1933...	25,368	105.0	26,368	109.2
1934...	27,981	115.8	29,481	122.1
1935...	31,600	130.8	34,100	141.2

Gold Movements

The total imports of gold into the United States in 1935 through Dec. 27, amounted to $1,742,077,590, as compared with $1,186,670,510 in the calendar year 1934. Total exports for the same period amounted to $1,960,-319, as compared with $52,758,664 in 1934. Net imports of gold amounted to $1,740,117,271, an increase of $606,-205,425, or 53.5 per cent, over the net imports in 1934.

In 1934 the United Kingdom contributed to the gold imports of the United States 43 per cent, France 25, Netherlands 9, Canada 7, British India and Mexico 6 per cent each; and in the period through Dec. 27, 1935, France contributed 55 per cent, United Kingdom 18, Netherlands 13, Canada 6, and British India 4 per cent of our gold imports.

The maldistribution of monetary gold was accentuated by the heavy influx of gold into the United States

(Continued on page 61)

SILVER

Year of heavy buying of metal by Treasury — After touching new high for movement, price breaks

Herbert M. Bratter

Formerly With Department of Commerce

POLITICAL AGITATION for raising the status of silver as a monetary metal attained new heights during 1935, particularly in the first half of the year. In January, 1936, the Treasury disclosed that 835,112,000 oz. had been acquired under the silver program from the time the new policies had become effective. This heavy buying proved only a step toward establishing either the $1.29 price level, sought through the Silver Purchase Act, or toward making the country's stock of silver equal one-third of the swelling stock of gold.

The year was characterized by several sudden changes in Treasury policy. Through April 24 the policy was to raise the price and buy; thereafter to mid-July the policy was apparently to let the price down, and not buy more than necessary to avoid a crisis; from July 13 through Dec. 7 the policy was to stabilize the price. After Dec. 7 its policy became bearish and, according to some observers, punitive. Evidently large offerings from China and Hongkong "turned the scales."

Just what the buying by the Treasury achieved pricewise is well illustrated by pointing out that the open-market quotation for silver in New York at the beginning of 1935 was 55c. per ounce. The high for the year occurred on April 26, when a quotation of 81c. was posted for foreign metal. The price closed the year at 49¾c. On two occasions the price paid for newly mined domestic silver was advanced. The first uplift took place on April 10, from 64½c. to 71.11c., and the second became effective on April 24, the President announcing that 77.57 would be paid for the domestic product.

After the rise to above 80c. in the world market, generally attributed to heavy speculative operations abroad, the Treasury's buying became noticeably less aggressive in the matter of acquiring the metal without some regard for price as well as to the obvious embarrassment, in mounting prices, to countries largely committed to the use of silver in their coinage systems.

Monetary Stock of Silver, Valued $1.29 per Ounce, and Amount Still to Be Purchased on Various Dates

Date of Statistics	Stock in Millions of Ounces	Monetary Value at $1.29 per Fine Ounce, Troy (Millions)	Estimated Total Silver Remaining to Be Purchased Under Silver Purchase Act Based on Gold Stock (Millions of Ounces)	(a) Total Acquisitions (Approximate) (Millions)
April 30, 1934	690.0(b)	$892.1	.....	4.8
June 30, 1934	694.6(c)	898.2	1,330.7	8.6
March 29, 1935	1,112.9(d)	1,445.4	1,090.2	399.3
July 31, 1935	1,166.6(c)	1,508.4	1,190.6	469.1
Dec. 6, 1935	1,456.5	1,883.1	1,134.1	761.8
Dec. 27, 1935	1,529.8	1,978.0	1,067.2	835.1

(a) From Treasury press release of Dec. 12, 1935. The periods covered differ slightly from those of Column 1. (b) From hearings on Silver Purchase Act of 1934. (c) From *Congressional Record*, Aug. 24, 1935. (d) Treasury press release of April 11, 1935.

The accompanying table on the monetary stock of silver, constructed from various Treasury releases, shows the results of the purchases on various dates. The acquisitions prior to June, 1934, represented only purchases of newly mined domestic silver under the proclamation of Dec. 21, 1933. The table illustrates the "treadmill" character of the Treasury's efforts to reach the stated objective of the Silver Purchase Act. During the period covered in the table gold was coming into the country in large volume. This automatically increased the requirements for silver.

In May, an unsuccessful attempt was made by Senator Thomas to link silver with the Patman bonus bill. In July, forty-six Senators signed a document asking the Administration to press the silver program "enthusiastically" until the price reached $1.29, whereupon the Administration reiterated its spirit of good faith in carrying out the Silver Purchase Act.

In Mexico the silver coinage reached its bullion point, its silver content becoming more valuable as metal than as money. China also became restive over the advancing price, and there were renewed representations to the State Department from Chinese Minister Sze.

Despite the sharp advance in price in April in the world market, the domestic price, contrary to expectations, was maintained at 77.57c. The Treasury's dilemma was acute. Politics required it to give the American miner a premium, or at least the world price. But if he were given a new premium with every speculative advance of the world price, the attendant publicity would serve simply to encourage speculators or others to lift the world price still further. It was like an endless chain, so a halt was called.

Senator Pittman was predicting $1.29 silver soon; but his much-lauded silver resolution of the London Conference of 1933 had become almost forgotten, outside of complaining China. It was that resolution which had urged "mitigating fluctuations in the price of silver," the avoidance of "measures which could appreciably affect the silver market," or which "would involve further debasement" of silver coinage, and substitution of "silver coins for low value paper currency." Here, through our policies, the very opposite of those objectives was being forced on a dozen foreign countries.

On April 27 Mexico issued three decrees providing for: (1) The demonetization of silver coins, the emission of 1-peso notes, and a prohibition on the exportation of old silver coins in any form; (2) the modification of the Law of the Bank of Mexico, by providing, among other things, for the establishment of a Board of the National Monetary Reserve, the diversion of profits on the purchase and sale of silver, gold, and foreign exchange to the monetary reserve, and a limitation on the emission of Bank of Mexico notes, together with fractional coins, to twice the commercial value of the monetary reserve; and (3) authorization of coinage of bronze 20- and 10-centavo pieces.

The issuance of bronze coins and paper notes, followed later by 50-centavo silver pieces of 0.420 fineness, eventually terminated the Mexican "crisis." It should be noted that Mexico was not then and is not now on a silver standard, but on a managed-currency basis. The crisis, unlike that of China, could therefore be remedied without altering the standard of value, merely by substituting for one type another type of subsidiary or fiat money. In both the Mexican and Chinese situations, however, our silver policy incidentally enabled the central governments to strengthen their control over the currency and banks.

During the summer months the market quieted down on steady buying of silver in the world market by the Treasury at what looked very much like a pegged price. From Aug. 26 to Dec. 7, inclusive, the New York quotation for foreign silver held at 65⅜c. per ounce. Subsequent events proved that much had been going on behind the scenes prior to and during this tranquil period.

In June, 1935, the British Government announced the appointment of its economic advisor, Sir Frederick Leith-Ross, as financial advisor to the British Embassy in China. The full story of his mission has not yet been told; but, it is believed, his transfer to China was in keeping with British efforts to secure international support for the Nanking Government to counterbalance the effects of the business depression in China and of Japanese encroachment in the North. It is said that the British first sought American, French, and Japanese participation in a mission to China. But, since there was a likelihood that the mission might discover our silver policy somewhat to blame for China's troubles, our State Department—however sympathetic—could not accept. Japan, for other reasons, also held aloof.

On Nov. 3 the Chinese authorities announced the definite abandonment of the silver standard in favor of a managed currency to be held stable in terms of the pound sterling and the dollar. Japanese militarists attributed this move to Leith-Ross' advice. In the history of silver, China's action was a momentous and depressing event. Carrying with it as a necessary consequence formal abandonment of silver in Hongkong, last remaining silver-standard government, it in theory made available to the United States Treasury in the form of possible future Government offerings vast amounts of the Orient's hoarded silver.

By the Chinese monetary measures of Nov. 3 all silver yuan and bullion in China were declared nationalized, the notes of the three government banks were made full legal tender, and silver yuan and bullion were demonetized. The

(Continued on page 62)

WORLD'S SILVER PRODUCTION

In Fine Ounces

Country	1932	1933	1934	1935
United States	24,762,000	20,955,000	26,441,000	38,600,000
Canada	18,347,907	15,187,950	16,441,361	16,413,000
Mexico	69,303,054	68,101,062	74,142,000	74,500,000
Peru	6,735,039	6,760,534	9,000,000	15,680,000
Other America	5,833,592	7,241,162	7,982,000	11,880,000
Europe	15,389,902	15,692,092	14,902,458	16,125,000
Australasia	9,522,726	11,552,397	11,900,404	12,100,000
Japan	5,260,576	5,967,362	6,920,000	7,900,000
India	6,947,000	7,300,000	6,850,000	7,000,000
Other Asia	1,066,765	1,784,208	1,775,000	1,850,000
Africa	3,445,167	4,070,834	5,233,771	5,300,000
World totals	171,600,152	169,412,601	185,587,994	207,348,000

Production statistics refer to new silver. Figures for 1932, 1933, and 1934 are by American Bureau of Metal Statistics; 1935 estimated by *E. & M. J.*

COPPER

Consumption abroad sets a new high record—Call for metal in United States again increasing

W. R. Ingalls

Director
American Bureau of Metal Statistics

CONSUMPTION OF COPPER in the United States in 1935 will probably be found to have been about 520,000 tons, supplied by production of about 360,000 tons of new copper, and the remainder by old copper and out of stock. This is an increase from about 465,000 tons in 1934 and is ascribable largely to increased manufacture of motor vehicles, increase in building, and increase in minor electrical appliances of many kinds. There was little or no increase in requirements of public utilities. Our residential building was about 144,000 units in 1935 vs. 72,000 in 1934, measured by contracts rather than by completions.

The consumption of copper ex U. S. A. has averaged about 98,000 tons a month. Production will have aggregated about 1,200,000 tons. Production ran wild during the first four months. Curtailment by agreement, especially by the producers of Africa and Chile, brought the rate down to about 95,000 tons per month in the second half of the year, which was substantially less than the concurrent rate of consumption. The statistics for production and consumption ex U. S. A. are expressed in terms of new copper, and consequently are on a different basis from those for the United States.

Consumption ex U. S. A. in 1935 was the largest of record. It was essentially industrial. War, or preparations for war, had relatively little to do with it. The low price probably had much to do with it. Although the foreign price rose temporarily to a little above 9c., that was still cheap copper.

The increase in consumption occurred most remarkably in Great Britain, Sweden, Japan, and Italy. The increase in Italy does not appear to have been associated especially with its colonial adventure, which was not of a nature to require much copper. Italy used a great deal more copper than in the previous year for the manufacture of bluestone, and its railway electrification for coal-saving absorbed a large quantity. Japan needed more copper for the development of Manchuria and for its manufacture for export to other countries, including British India. The total consumption of copper in British India increased substantially, although statistically it is credited largely to other countries that manufacture for it.

I have been asked, however, to dwell upon the outlook for 1936 rather than the history of 1935.

As to the United States, we may confidently expect a further increase in consumption. I might dismiss this with the broad explanation that we are probably in economic recovery that will be sustained. Specifically, we may expect another year of large manufacture of motor vehicles. A completion of the building contracts made in the second half of 1935 should definitely call for more copper, and the building statistics have every look of being on the upgrade. The statistics indicate that we continue to use more and more pounds of copper and brass pipe per housing unit. The more houses, the more telephones and public utility services are required. An expression of that in terms of copper may be expected in 1936. The steady upward trend in kilowatt-hours of electric current per domestic unit suggests more requirement of copper for electrical manufactures.

There are some negative factors that we should not overlook. Our rate of population increase continues lower than it used to be. A new policy of the automobile manufacturers, introduced to level their seasonal ups and downs, exaggerated their use of copper in 1935 at the expense of improvement in 1936. In some important channels there is a tendency to use less copper than formerly—e.g., trolley lines become replaced by motor buses, and in telephone plants there is a trend toward less use of copper per unit.

As to the outlook for consumption abroad, discernment is more difficult. In Great Britain the building program is not yet completed, but it is thought to be approaching culmination. Russia constantly improves economically through increasing gold production, but is not yet able to supply itself entirely with its own copper. The outlooks in France and Germany are uncertain. As a broad generalization, electrification proceeds everywhere and is promoted by the low price for copper. We may forecast for 1936 a consumption ex U. S. A. as large as in 1935 and possibly larger.

On the side of production the capacity in the United States is larger than any requirement of it that will occur in 1936. Producers will benefit from some increase in operating rates, but still will have to keep throttled down.

In the foreign position there is also ability to produce in excess of any demand reasonably to be expected, and concerted constraint will continue to be needed. About 25 per cent of the foreign production is scattered among countries which, because of their several national economies, will produce all they can. Some promising new orebodies are being discovered in the Baltic countries by geophysical prospecting and a mine in Asiatic Turkey has only recently received railway connection with the sea.

I have refrained from discussing the position of stocks. They have been experiencing some reduction, but continue to be large. However, a good deal of the accountable stock is in process, in transit, etc., and comes under the head of constant lock-up. We have seen from past experience that the copper industry, like others, has a tendency to be wishful for carrying less stock than is necessary for economic safety; and we have seen in 1935, not for the first time, that a large stock is not an unendurable incubus or preventive of rising price when the economic trend is upward.

WORLD'S COPPER PRODUCTION

In Short Tons

Country	1932	1933	1934	1935
United States	255,509	233,649	232,299	363,500
Canada	125,370	148,290	183,415	209,400
Mexico	37,588	43,742	52,116	45,000
Chile	113,728	180,319	282,303	285,000
Peru	23,610	27,327	30,373	32,200
Germany	34,061	34,171	26,455	25,000
Russia	33,816	36,034	48,587	80,000
Other Europe	96,691	119,007	124,536	126,000
Japan	68,100	67,000	66,100	66,500
Africa	155,184	200,430	292,525	288,000
Elsewhere	43,316	47,230	43,220	65,000
World totals	986,973	1,137,199	1,381,929	1,585,600

Statistics are based on blister copper, referred to countries wherein ore originated. Figures for 1932, 1933, and 1934 are by American Bureau of Metal Statistics; 1935 estimated by *E. & M. J.*

LEAD

Larger tonnage moved during 1935 at higher prices—Outlook for current year is encouraging

F. E. Wormser

Secretary
Lead Industries Association

APPLYING to the lead market for 1935 the principal test by which its character is generally judged—namely, the price at which the metal sold during the year—1935 was without doubt the best year the lead-mining industry has enjoyed since 1930; and if, to the improved lead price, we add such favorable developments as an increased demand and a slight decrease in stocks, there is indeed more room for cheer over lead than for some time past.

The improvement in the lead market is readily noted by a comparison of the average annual price of New York lead for the past ten years, as follows:

Average Annual Lead Price

Cents per Pound, New York

1926.....	8.417	1931.....	4.243
1927.....	6.755	1932.....	3.180
1928.....	6.305	1933.....	3.869
1929.....	6.833	1934.....	3.860
1930.....	5.517	1935.....	4.065

Improvement was noted early in the spring of 1935, but after a short-lived rise, the market sagged in the general business uncertainty over the effect of the Supreme Court's NRA decision. Subsequently, buying was resumed in a volume sufficient to lift the market to 4.50c. per pound, and to keep it there week after week. As a matter of fact, the demand for lead during the last quarter of the year was at a rate of about 43,000 tons per month, the highest rate since the fall of 1930, and, so far as may be ascertained, the lead purchased is moving into the manufacture of finished lead products and does not represent speculative buying.

Lead stocks in the hands of manufacturers have been low during the depression, but at the end of 1935 were only slightly greater than they were at the end of 1934. On the other hand, lead stocks of sellers showed a slight decline, but continue to be over 200,000 tons of refined lead. Fortunately, they remain in the possession of companies whose financial strength has, if anything, improved substantially during the year, and they are well able to carry this burden, which was accumulated largely in an effort to maintain employment at the highest rate possible.

Production of domestic lead (including some scrap smelted at primary smelters) during 1935 totaled about 373,000[1] tons, compared with an output of 362,000 tons in 1934. This is still to be considered a relatively low rate of output—something which might have been expected back in the early years of the twentieth century.

The high domestic price of silver probably stimulated some lead output which would ordinarily have remained in the ground, but even if the entire increase in the amount of lead produced in 1935 over that produced in 1934 is accredited to the influence of high silver prices, this factor will be seen to have been small.

World production of lead increased only slightly in 1935 over 1934. It is interesting to observe that during the depression total world production has not shown nearly the severe decline witnessed in the United States' market, as the following tabulation indicates:

Relation of United States to World Production(*a*)

In Short Tons

	United States	Remainder of the World	Total
1928.....	650,000	1,191,000	1,841,000
1929.....	688,000	1,244,000	1,932,000
1930.....	593,000	1,255,000	1,848,000
1931.....	411,000	1,125,000	1,536,000
1932.....	277,000	1,022,000	1,299,000
1933.....	293,000	1,023,000	1,316,000
1934.....	331,000	1,158,000	1,494,000
1935(*b*).....	340,000	1,170,000	1,510,000

(*a*) A.B.M.S. (*b*) Estimated.

For five years, 1931 to 1935, inclusive, the production of new lead from primary smelters, including some scrap smelted in connection with ore, has averaged only 340,000 tons a year, compared with an average of 770,000 tons a year for the five years 1926 to 1930, inclusive. This has undoubtedly left a big void which will have to be filled some day, and is one of the thoughts that makes the future of lead appear extremely favorable. Of course, there weren't large recoveries of scrap metal back in the early 1900's as there are today, and the influence of scrap metal must temper one's conclusions.

Secondary-lead production during 1935 is estimated to have been about 13 per cent above the record for 1934, a relatively larger growth than for primary production. Probably 175,000 tons of old battery plates were shipped to smelters and other users in 1935. Although higher lead prices might be expected to draw a large supply of scrap metal to the smelters, there is little indication that this hypothesis is true.

The consumption of lead in pigment manufacture shows pronounced improvement, especially white-lead production. Important as storage-battery manufacture is to the prosperity of the lead industry, so much scrap lead is returned from old batteries periodically that it does not compare with the importance of white lead, red lead, and other lead pigments. In the years 1925 to 1929, inclusive, some 280,000 tons of lead pigments were manufactured; in 1935 the output was about 225,000 tons. About 45,000 tons of this production in the form of red lead and litharge was consumed in storage-battery manufacture.

It is quite likely that building construction will grow in 1936, so that not only should lead stand to benefit from a greater consumption of white lead in paint, but it should profit from an increased use of other lead products which are used in home construction, such as sheet lead, lead pipe, and solder. But if there is one development which above all others would help the lead market it is a settlement of the utility situation, and a renewed expenditure of capital for enlargement of utility facilities.

WORLD'S LEAD PRODUCTION

In Short Tons

Country	1932	1933	1934	1935
United States.....	277,435	292,543	330,911	376,500
Canada.....	129,713	129,932	159,833	162,500
Mexico.....	143,621	139,738	193,547	197,000
Germany.....	104,939	128,528	132,276	142,500
Italy.....	34,690	27,289	46,241	39,000
Spain.....	120,998	102,473	82,516	75,000
Russia.....	20,632	15,070	29,954	40,000
Other Europe.....	130,906	130,606	154,425	153,000
Australia.....	208,577	233,532	226,336	245,000
Burma.....	79,748	80,694	80,437	80,700
Elsewhere.....	47,858	36,534	58,267	61,000
World totals.....	1,299,117	1,316,939	1,494,743	1,572,200

In general, in terms of base bullion, allocated as far as possible according to origin of ore. Figures for 1932, 1933, and 1934 by American Bureau of Metal Statistics, 1935, *E. & M. J.* estimate.

[1]Lead production statistics as reported by various agencies will be found to differ considerably. The variations are generally due to the inclusion of scrap lead in some estimates and not in others, or to differences in the manner of considering antimonial lead.

ZINC

Recovery in the industry in this country is on sounder basis than other major non-ferrous metals

Norman Hickman
Manager of Sales
The American Metal Company, Ltd.

THOUGH influenced by more or less the same forces of irregular and partial economic recovery which were felt by the other non-ferrous metal markets, the zinc market was able to register during 1935 a somewhat sounder and more consistent improvement than that of copper and lead.

The year started with the market, particularly that of the price-determining common-metal division, still handicapped by overproduction, ample if not burdensome stocks, and inadequate smelting margins. For most of the smelting plants dependent on the Tri-State ore supply these smelting margins averaged less than $10 per ton. The position of High Grade zinc was essentially sound, with stocks negligible and current consumption fully equaling the supply.

The first two months of the year were rather featureless. Buying was moderate, although shipments increased slightly. No significant price change occurred until late in February, when substantial consuming demand appeared, somewhat accentuated by increasing evidence that smelting operations were being curtailed. The published statistics for April of 1935 revealed the first definite turn for the better since the preceding summer.

Renewed large-scale inquiry developed in early April, the sizable demand for near-by metal reemphasizing the light inventory position of most consumers.

By five-point stages the market rose from 3.90c. to 4.10c., which was reached about the middle of April. During the month of April common metal shipments to consumers exceeded 19,000 tons and production of this grade of less than 16,000 tons reflected continued curtailment. Lessened demand for Tri-State ore and continued full production in that camp served to prevent an advance in the ore market, which continued at $26. Ore stocks increased gradually, reaching about 28,000 tons at the end of April.

Strike threats had been disturbing the Tri-State district, and culminated on May 8 in a general strike throughout the field. At the same time a strike closed the Mascot mine, in Tennessee. For about a month the Tri-State strike seriously affected production; however, by June 8 about half of the mills had resumed operations, and though trouble continued in various quarters, necessitating the presence of militia, operations gradually returned to normal, with production regaining by mid-August its rate prior to the strike. During the curtailed ore production period, ore had become increasingly difficult to obtain at the $26 level, the bulk of the stocks on hand being held for higher prices. As a result, a price of $28 was established on June 8 and raised to $29 in early August. Before the end of 1935, the quotation for ore advanced to $32.

In the meantime, buying of metal had continued on an increasing scale, and the price during May rose to 4.30c. The buying was well diversified and reflected a steadily rising rate of consumption in all the principal zinc-consuming industries, purchases for galvanizing account being particularly heavy. The 4.30c. market held firmly through the relatively quiet period of June and early July. Though the Tri-State strike did not spread to the zinc smelters, it was symptomatic of a period of labor unrest which did affect many of the smelters. The tendency throughout the year was for higher labor costs.

During the second half of July aggressive buying was resumed, and the heaviest sales period so far in the year ensued, carrying the market to 4.40c. in late July and to 4.50c. in early August. Galvanizing operations had expanded steadily and had reached, on an average, a 75 per cent basis, with some plants running close to 100 per cent of practical capacity.

August shipments were 10,000 tons higher than those of June, and common zinc shipments approached 20,000, as against the preceding year's average of 15,000. The activity further developed through September, when total shipments reached a new high for the year, resulting in the largest monthly stock decrease so far in the year. Two buying waves occurred during the remainder of the year, one in early October, when the market rose to 4.85c., and the other a month later, when considerable metal was booked at the same level for early 1936 delivery.

Marketwise, December was quiet, and a threat to a further price advance came from abroad, where the zinc market had traveled no such auspicious course as ours and had drifted down to a point where importation over our tariff barrier was, though not immediately probable, a possibility not to be overlooked. A detail discussion of the plight of the European market is beyond the scope of this review. Suffice to say, production abroad has continued heavy, stocks have probably risen, and consumption, particularly of galvanizing, has been disappointing. Tariffs, currency restrictions, quotas, and nationalistic production programs also combined to complicate an approach to improvement, and attempts to revive the zinc cartel have been so far fruitless. The present low prices, equivalent to 3.20c. per pound at the year-end, as against a high of 3.82c., may provide a compelling force to a constructive solution of the foreign market's difficulties.

The year's statistical record is impressive, particularly its cumulative strength. The average monthly shipment rate for the entire year—38,760 tons—was higher than for any year since 1929. At the end of the year, and as a natural result of the heavy fall buying, forward commitments of the price-determining common metal were about 51,000 tons, or 20,000 tons higher than at the beginning of the year. Stocks of this grade at the year-end were 72,000 tons, or about 32,000 tons lower than at the beginning.

In reviewing 1935 a few aspects of the market stand out with interesting significance. It is possibly forgotten

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WORLD'S ZINC PRODUCTION

In Short Tons

Country	1932	1933	1934	1935
United States	213,531	324,705	366,933	431,085
Canada	86,152	91,227	134,926	146,000
Mexico	33,454	30,712	40,354	43,000
Belgium	106,185	151,346	192,885	195,000
France	54,376	61,217	56,410	55,000
Germany	46,276	56,071	80,358	136,000
Great Britain	30,101	45,987	57,344	68,000
Poland	93,640	93,397	102,522	92,000
Australia	59,144	60,425	59,353	72,000
Rhodesia	.....	20,767	21,882	22,500
Elsewhere	145,427	169,017	188,628	200,415
World totals	868,286	1,104,871	1,301,595	1,461,000

Production of zinc by primary metallurgical works. Figures for 1932, 1933, and 1934 are by American Bureau of Metal Statistics; 1935 estimated by *E. & M. J.*

TIN

Renewal of international production-control agreement in 1936 held promising despite obstacles

E. Baliol Scott

Editor, "The Mining Journal," London

IF EARLIER YEARS have given tin producers their fill of trouble and anxiety, 1935 may be characterized as the consumers' and dealers' period of torment. When we consider that stocks apart from the Buffer Pool, which was entirely under control, were practically the same at the end of 1934 as at the end of 1935, it is obvious that the International Tin Control had the supply situation well in hand at the beginning of the year; and the tribulations inflicted on the trade, seen in retrospect, appear to have been quite unnecessary.

The failure of the Tin Control to function smoothly was due entirely to the extraordinary delay in increasing the quotas. It is only a very partial explanation to attribute this procrastination to the desire to liquidate at as high a price as possible whatever remained of the private pool and the Buffer Pool, which was not completed until sometime after the New Year. What is not explained is why the way was not cleared earlier in the year for an increase in quotas, by the rapid disposal of the pools. It is generally understood that a negative voice at a meeting of the "signatories" is sufficient to prevent a change in quota. Indeed, this is one of the conditions which it is desired to change in any new agreement that may be reached. The Dutch being on gold, maintenance of high prices is more vital to them than to the other "signatories," and this influence was probably largely at the back of the delay that caused the tin famine.

The international quota for the first quarter of 1935 stood at 40 per cent of standard tonnages; for the second quarter at 45 per cent. Thereafter the increases were large and irregular. In June the quota for the third quarter was advanced to 50 per cent. Then on Aug. 9 this rate was advanced to 65 per cent, retroactive to July 1. In September it was decided to continue this rate to the end of the year, but on Oct. 3 the quota was made 70 per cent retroactive to July 1. Again on Oct. 22 it was increased to 80 per cent, and on Dec. 6 the quota was advanced to 90 per cent for the first quarter of 1936.

These constant vacillations make obvious the fact that it is impossible to give a close figure of world production at the time of writing. As these increases in quota are to a large extent retroactive, it cannot be ascertained how quickly the different restricted countries can step into their authorized production. So far as it is possible to calculate at the present writing, the 1935 output would appear to have been more than 135,000 tons.

At the 90 per cent quota coming into force at the beginning of 1936, world production should be of the order of 185,000 tons, though some computations run up to 190,000 tons. The disproportion between this figure and the 1935 output is startling and we are at once thrown back on the consideration of what the rate of consumption is likely to be. The visible supply at the end of the year looks much the same as at the end of 1934. If to the production of say 135,000 tons there be added 8,000 tons for the Buffer Pool stock disposed of, we get an indicated delivery of 143,000 tons. But there would appear to have been a considerable accumulation of tin in Holland during the year which may represent a larger stock than the trade statistics include. Other estimates put consumption lower.

On the other hand, the practice of delivering tin ex works has much expanded during the year, and this tin does not appear in the figures for deliveries. Consequently, consumption or absorption of tin by users is probably a considerably higher rate than indicated by the usual delivery figures.

It is generally agreed that 160,000 tons is the highest point which consumption has ever reached. Even if such a rate of absorption be assumed, production henceforth would be at the rate of some 25,000 tons per year above the previous best. In this connection reference may be made to some statistics recently published by the British Metal Corporation, which estimated the United Kingdom consumption of tin in the first half of 1935 at an index figure of 88, compared with 104 in 1929, and a tonnage of 21,000 tons, compared with 25,000 immediately before the War. What is true of Great Britain does not necessarily apply to that much larger consumer, the United States, but the inference is that consumption of tin has not that elastic property possessed by the other base metals the use of which in the United Kingdom was much larger in 1935 than in 1929. Anyway, taking the most favorable view of the situation possible, there should be at least 6,000 tons per quarter produced in excess of absorption. Owing to lag in reaching quota, the first quarter may not produce the full excess, but it is very roughly estimated that, with total visible supply around 16,000 tons, the first quarter of 1936 will be acceptable to the International Tin Control as bringing stocks up to what the Control considers a safe basis. But thereafter it certainly appears as though quotas must once more be cut back if the visible supply is to be maintained in the neighborhood of 20,000 to 22,000 tons.

One of the outstanding questions which will have to be answered during the year is the success or failure of the efforts now being made to renew for a further term the Tin Agreement expiring at the end of 1936. It is generally reported that a longer period is aimed at —viz., five years. In such a period great changes may ensue.

It was announced in the fall that the four signatory countries had agreed to maintain their present ratio towards one another. Consequently, any extensions of quotas to associated or outside countries would be shared equally. Of the four signatories, the Netherland East Indies, so long as they remain on gold, are more interested in price than in tonnage; Malaya is the reverse, being a cheap producer, and Bolivia, in view of her absolute dependence on revenues

(Continued on page 62)

WORLD'S TIN PRODUCTION

In Long Tons

Country	1932	1933	1934	1935
Bolivia	20,584	14,746	20,634	26,875
Great Britain	1,337	1,543	1,812	1,900
China	7,125	8,200	8,500	8,675
Burma	3,168	3,472	3,600	3,650
Malaya	28,400	23,768	34,127	46,000
Siam	9,261	10,324	10,587	10,700
Netherlands E. Indies	14,901	14,181	18,418	25,000
Australia	2,138	2,810	3,000	3,200
Nigeria	4,174	3,651	4,935	7,000
Congo	683	2,225	4,602	6,000
Elsewhere	4,697	3,052	3,821	5,500
World totals	96,468	87,972	113,746	144,500

Tin production on ore basis. Source: American Bureau of Metal Statistics for 1932, 1933, and 1934; *E. & M. J.* estimate for 1935.

NICKEL

Consumption is now largest in the history of the industry—Bulk moving into peace-time uses

Robert C. Stanley
President
International Nickel Company of Canada

STATISTICS for the first ten months of 1935 indicate that the year's business in nickel was the largest in the history of the industry. World consumption of nickel in all forms during the first ten months of the year amounted to 133,300,000 lb., which compares with 112,481,600 lb. in the first ten months of the previous peak year, 1929, and with 102,780,000 lb. and 77,600,000 lb., respectively, in the similar periods of 1934 and 1933.

Although this further increase in consumption undoubtedly reflects a tendency among certain world powers to strengthen their metal reserves, analysis of world nickel consumption definitely shows that the great bulk of the metal continued to move directly into established peace-time uses. Nickel alloys are now specified where simple metals had previously been used.

As a basic material, nickel has been among the first commodities to feel the impulse of returning industrial activity. Reports from all centers indicate a general restocking of bins and replacing of obsolete equipment. This is a development which logically follows a prolonged period of industrial curtailment. In this connection it is significant that nickel is now employed in one form or another by major industries, and that there are in world markets more than 1,000 trademarked alloys containing nickel.

The progress made by the stainless steels during recent years when most steel production was seriously curtailed inspires confidence in the future of these alloys, which now constitute the second largest outlet for nickel in Great Britain. In this future the nickel industry has an important participating interest because of the rather high nickel content in stainless steel.

Two other classes of alloy steels have been utilized for supplementary applications in the field of weight saving. Experiments with low-alloy, corrosion-resisting steels led to the development of intermediate alloys in which nickel and copper (with or without other additions) are essential elements. The other class is that of the low-cost, nickel-manganese cast steels.

Of significance from the point of view of the nickel industry is the growing interest in alloy cast irons. Consumption of nickel for alloy cast iron is increasing rapidly.

Among the bronzes of the structural grades there has been a definite trend toward the use of nickel with tin to improve mechanical properties and to lower production costs. The practice is also expanding of making small nickel additions to high lead bronzes to prevent segregation, or "lead sweat," and to improve resistance to compression.

The attractive features of nickel-bearing aluminum alloys are gaining greater recognition, the principal applications today being pressure die castings, aircraft pistons, cylinder heads, and automotive pistons. Such alloys have excellent casting qualities and good surface finish and machinability. A light aluminum alloy containing nickel has been developed recently by The Aluminum Company of America.

PRODUCTION OF NICKEL IN CANADA

	In Pounds		
	1933	1934	(a)1935
January	1,784,264	9,259,066	9,390,437
February	1,993,863	7,261,301	8,790,996
March	3,285,427	10,426,462	10,618,462
April	2,139,886	12,911,552	11,836,091
May	5,490,911	10,023,950	11,330,388
June	8,065,940	13,388,307	11,665,507
July	9,255,033	10,649,811	10,189,261
August	10,216,700	14,257,921	10,869,647
September	10,645,933	8,764,513	12,896,865
October	10,734,268	8,893,458	13,357,653
November	10,847,417	12,147,283	.....
December	8,805,016	10,703,716	.....
Totals	83,264,658	128,687,340	(b)139,194,348

Source: Dominion Bureau of Statistics. (a) Subject to revision. (b) Preliminary estimate for twelve months.

GOLD . . *Continued from Page 55*

in 1934, but since much of the gold which came here from Europe in 1935 was derived from gold hoarded outside of the monetary reserves of the central banks, the movement was favorable in releasing hoarded gold to monetary use and not unfavorable to the distribution of monetary gold. Investment in American securities on such a scale is evidence that the European investors have confidence in our economic recovery. The threat of war not only stimulated foreign investment in American securities, but also resulted in gold being sent here for safer keeping. Another, although a minor influence in the heavy gold movement to the United States, was the repatriation by Europeans and South Americans of their bonds held in this country. The return of American money sent previously abroad was a practically negligible factor in our gold imports, for the reason that most of our money sent to foreign countries in 1932 and 1933 was brought home in 1934.

Reflation

Reflation to higher commodity price levels, both here and abroad, seems inevitable during 1936, and the costs of mining gold will tend to increase. The Federal Reserve Board was endowed with ample and additional authority to minimize the adverse effect of excess gold reserves in the Banking Act of 1935, but much depends on how rigidly the Board will exercise these new powers to hold reflation within reasonable bounds and to prevent actual inflation of a damaging character. There is no reason for any extensive or sharp rise in commodity prices, but even the limited reflation which is expected to occur will increase gold-mining costs throughout the world, and this, with the additional burden of taxation, will be registered in increased economic pressure on the industry. To offset some of this pressure it is expected that the price of gold will have a tendency during 1936 to rise in terms of the currencies of some of the principal gold-mining countries. Without a scaling down of taxation on the gold-mining industry, especially in the centers where such taxation is most burdensome, as in New Zealand, South Africa, and Canada, it is not probable that the present accelerated rate in the annual increase in the world's gold production can be maintained in 1936 and later years.

New Zealand has recently rejected the plea of the Gold Mining Association of that country to reduce the export tax on gold, so that there is little prospect for relief in that quarter. General Smuts, however, has recently recognized the need for tax reform

in South Africa. An extensive curtailment of taxes in South Africa would pave the way for large investments in new plant and equipment for the newly discovered extensions of the gold reef, and plant enlargements and modernization in the older areas. Such permanent improvements would surely benefit South Africa more for years to come than the temporary advantages to be gained through oppressive taxation. Though Canadian taxes are not so high relatively as those of South Africa, a marked scaling down would prove beneficial to Canada in the same way.

In this country, California has been considering the levying of additional taxes on the gold-mining industry. In other Western States taxes on the production of gold are high. All taxes on gold production should be reduced to nominal everywhere throughout the world, primarily because gold in its monetary status has been and probably will continue to be a public utility of the first order, and secondly because the localities in which gold is produced, whether in this country or abroad, will in the long run benefit more by extending the life of the industry than they possibly can through the tax revenues derived at the expense of the growth of the industry. And finally it must be emphasized that as world economic recovery proceeds, other attractive fields will compete more intensively with the field of gold-mining investment and that as time passes the acquisition of new capital for developing gold properties, however attractive, will become more difficult.

TIN . . . *Continued from Page 60*

from tin, probably approximates more to the Dutch outlook.

The chief difficulties which a fresh term of restriction has to face is the prospect of demands from the Congo and Siam, which would oblige the signatory countries so to reduce their quotas once more as to cause one or more of them to withdraw and prefer the alternative of unrestricted output and the probability of low prices for an unknown period. So far as I can learn, despite reports to the contrary from the East, no agreement has yet been reached regarding the Belgian Congo, and still less as regards Siam. Belgium gossip states that a quota of 15,000 tons had been practically arranged when the signatories changed their minds. It seems unlikely that a flat rate will be continued in a new agreement, so the story perhaps means only a standard tonnage of 15,000 tons to be reduced pro rata with the co-signatories. A cable from Bangkok a few days ago declared that Siam wanted a basic quota of 25,000 tons, without which that country would stand outside the agreement. Obviously, if these figures, together amounting to 40,000 tons, or anything like them, were conceded as a flat rate, the present signatories could hardly hope for anything better than 60 per cent of international quota, or a very considerably lower percentage of their domestic quota, which means current potentiality. Certainly, if the allowance to the Congo, with a production of 1935 of 6,000 tons, were increased to anything like the figure indicated, Siam would not be content without a corresponding addition.

It is impossible to speak with any certainty about matters where secrecy has become the first principle and where so many foreign countries have to be consulted and satisfied. But looking at the position purely objectively, it is not unreasonable to expect that the negotiations will proceed slowly; and it is even possible that an occasional threat of failure may be allowed to disturb prices so that recalcitrants may be brought to realize what their obstinacy threatens to their own position. In most quarters, however, the impression at present is that restriction will be renewed some time in the course of the year.

SILVER *Continued from Page 56*

"silver clause" was abrogated; exchange stabilization was declared as the Government's intention, and a currency reserve board was provided for, with specially promulgated regulations. From present indications stabilization of China's exchange through silver exports depends in part for its success on the United States Treasury's silver-buying policy. There is reason to suppose that not all of the unofficial exports of silver from China during 1935 have been smuggled. It is even possible that the Government itself exported silver. Latterly it has been reported that Chinese shipments of silver in December (after the price decline) represent Treasury purchases arranged prior to the decline. Doubtless much more Chinese silver is similarly available, if the Treasury wants it.

The deflation crisis in China was not entirely due to the United States' silver policy, although greatly aggravated by it. Nor was it an unmixed evil for China, since it is helping bring about Chinese currency reforms long needed. On the other hand, there is always the possibility —in China a strong one—that a managed currency will be abused in time of stress. And there is much stress ahead for the Chinese nation. In passing, it should be noted that Manchuria's currency has been divorced from silver and pegged to the yen.

Early in December the supplies of silver offered through London to the Treasury became very large. The offerings, of course, originated in the Far East. On Dec. 9 the Treasury suddenly withdrew its support from the market, and in the following fortnight the price of foreign silver broke badly. On Dec. 10 the London bullion brokers were unable to fix a quotation. The change in the policy of purchasing silver was "in the public interest," according to Secretary of the Treasury Morgenthau, but official explanation was lacking. In silver circles the move was coupled to monetary and exchange developments in China. Whether it has yet run its course cannot be stated; there is at least the risk that the Treasury's new policy bodes no good for silver. All depends, naturally, on silver's strength in Congress. As to the prospects for foreign silver in 1936, those in intimate touch with the situation are unanimous in pointing to Washington for the answer, whence comes no definite information as to future policy.

ZINC . . *Continued from Page 59*

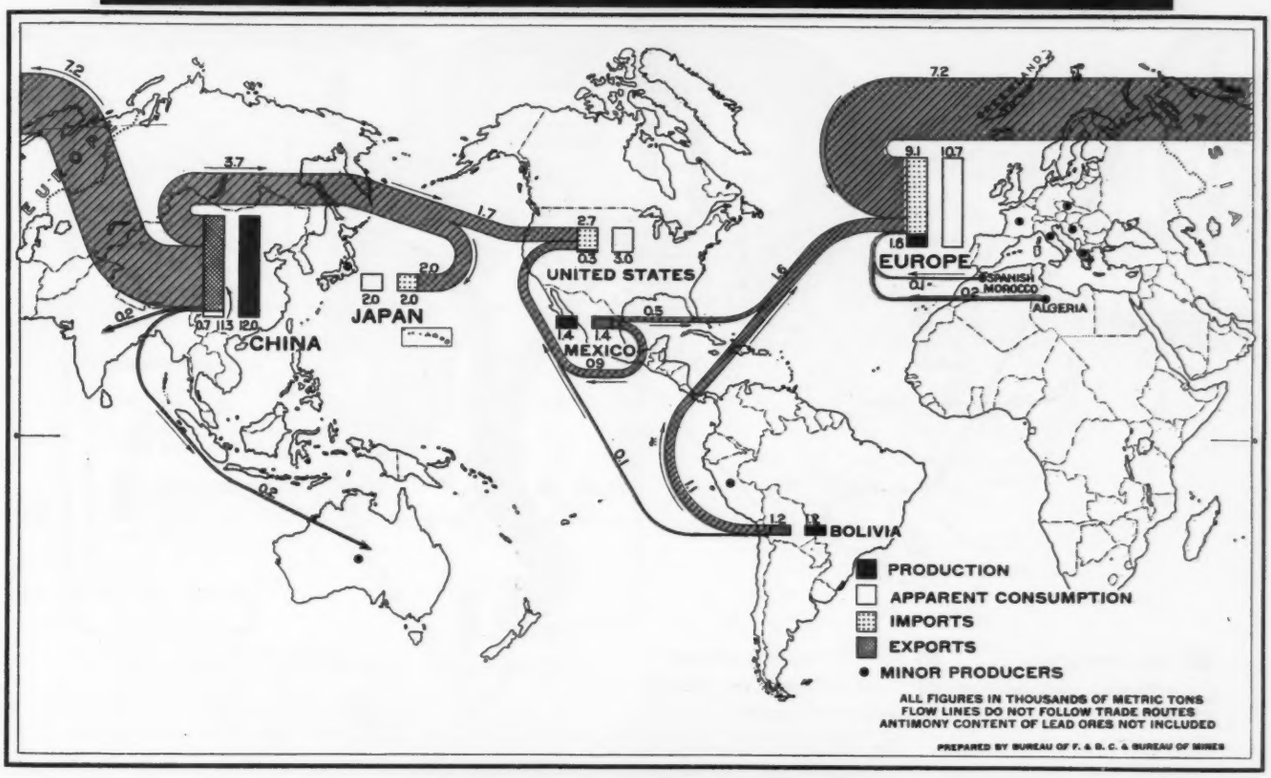
that the zinc industry had a code under the NRA. It was an uncomplicated affair, concerned principally with maximum working hours and minimum wages. Approved on March 26, it had a brief and uneventful life until the demise of NRA on May 27. Many believe that the zinc industry benefited by there being attached to the code no marketing provisions which might have operated over a longer period.

With regard to consumption, the outstanding features of 1935 were, first, the heavily increased use of zinc alloys in die-castings and the development of many new uses for such castings, particularly in the automobile field, and, second, the marked pick-up in galvanizing operations.

Particularly noteworthy was the steadiness of the zinc market throughout the various quiet periods of 1935. Aside from a 2½ point irregularity at the beginning of the year, no advance established in the ensuing months was lost; and, significantly, no unduly long period intervened between buying waves and no excessive amount was sold at any one price. The successive advance permitted an orderly liquidation of much surplus stock, and the steady decline in the latter would seem to indicate that holders were content to achieve a reasonable average. Production was also held within reasonable bounds and was only moderately increased toward the end of the year, when lower stocks on hand and increased demand made it advisable in various directions. The price advances, too, were of a modest nature and led to a figure, 4.85c., which, though a gratifying improvement on the loss-impelling price of the year's beginning, is nevertheless reasonable and moderate. Moderation, in fact, seems to have been a keynote of the zinc market during 1935.

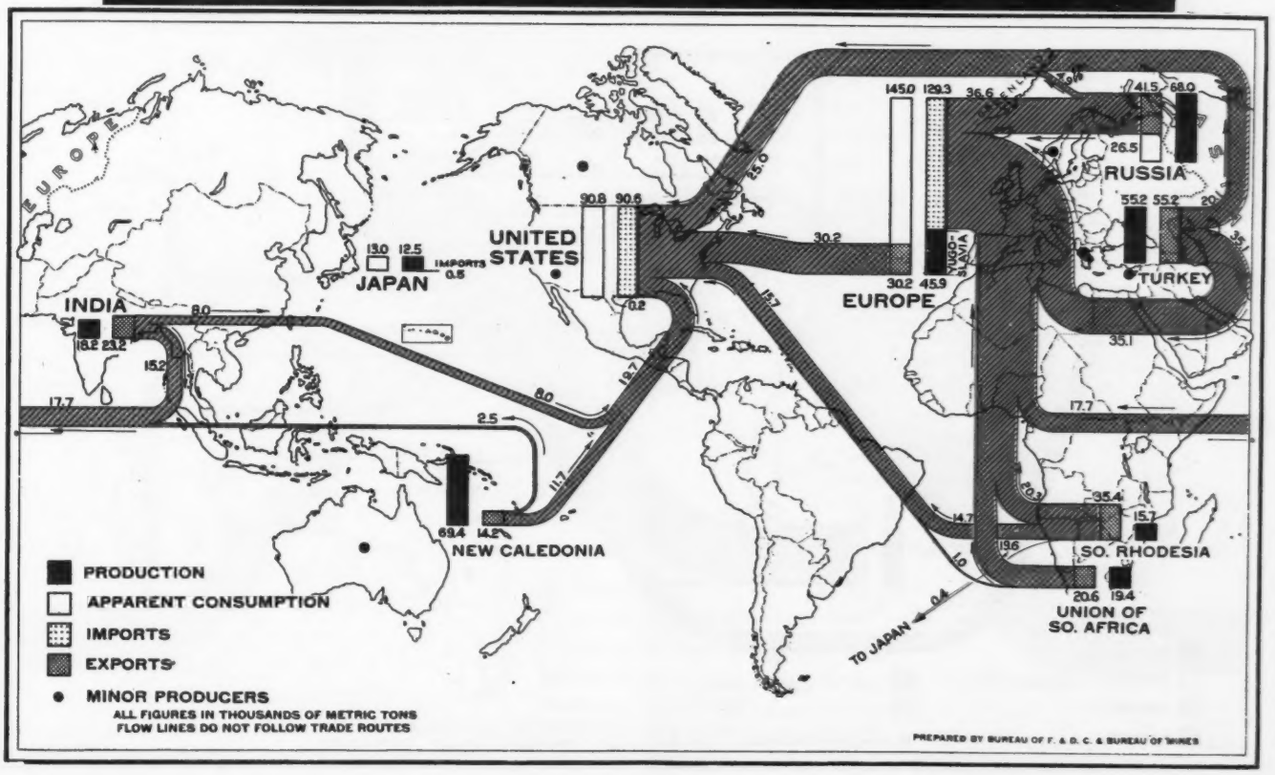
ANTIMONY

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



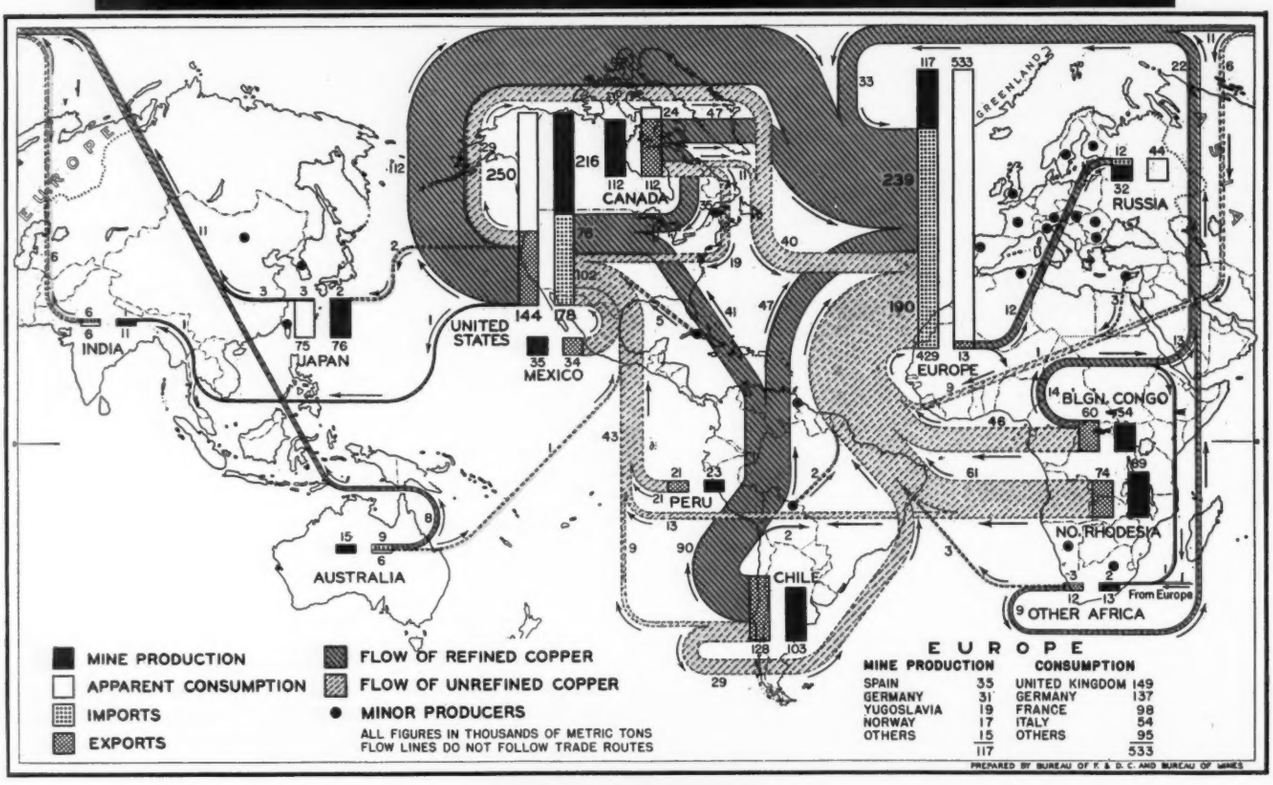
CHROMITE

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



COPPER

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932

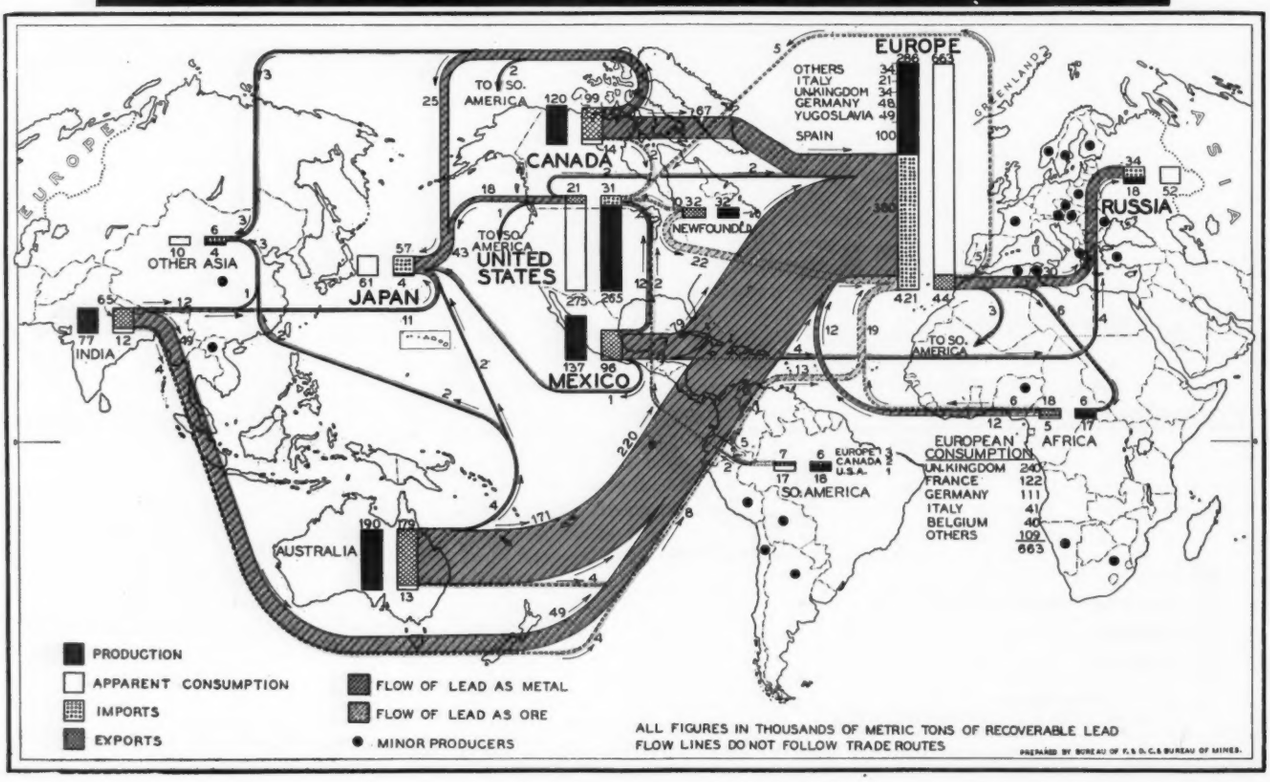


EUROPE

MINE PRODUCTION		CONSUMPTION	
SPAIN	35	UNITED KINGDOM	149
GERMANY	31	GERMANY	137
YUGOSLAVIA	19	FRANCE	98
NORWAY	17	ITALY	54
OTHERS	15	OTHERS	95
	117		533

LEAD

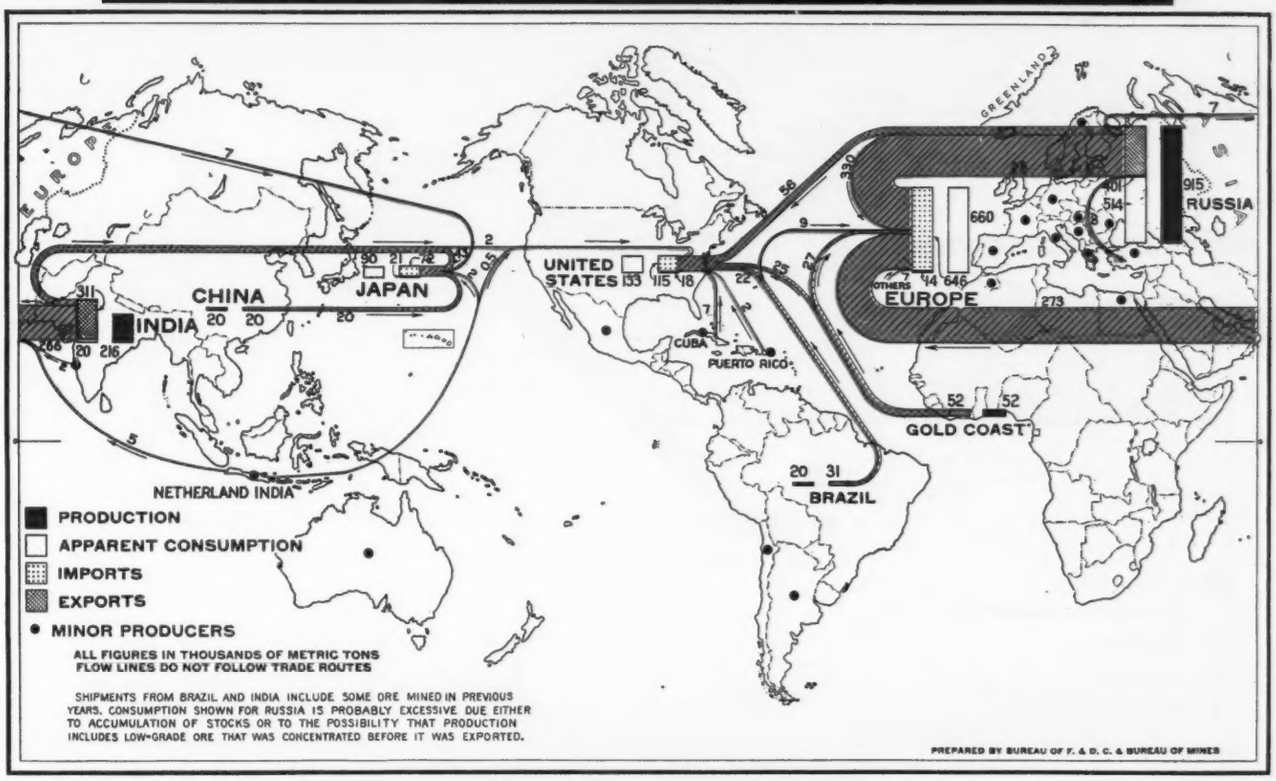
WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



EUROPEAN CONSUMPTION	
UNITED KINGDOM	240
FRANCE	122
GERMANY	111
ITALY	41
BELGIUM	40
OTHERS	109
	663

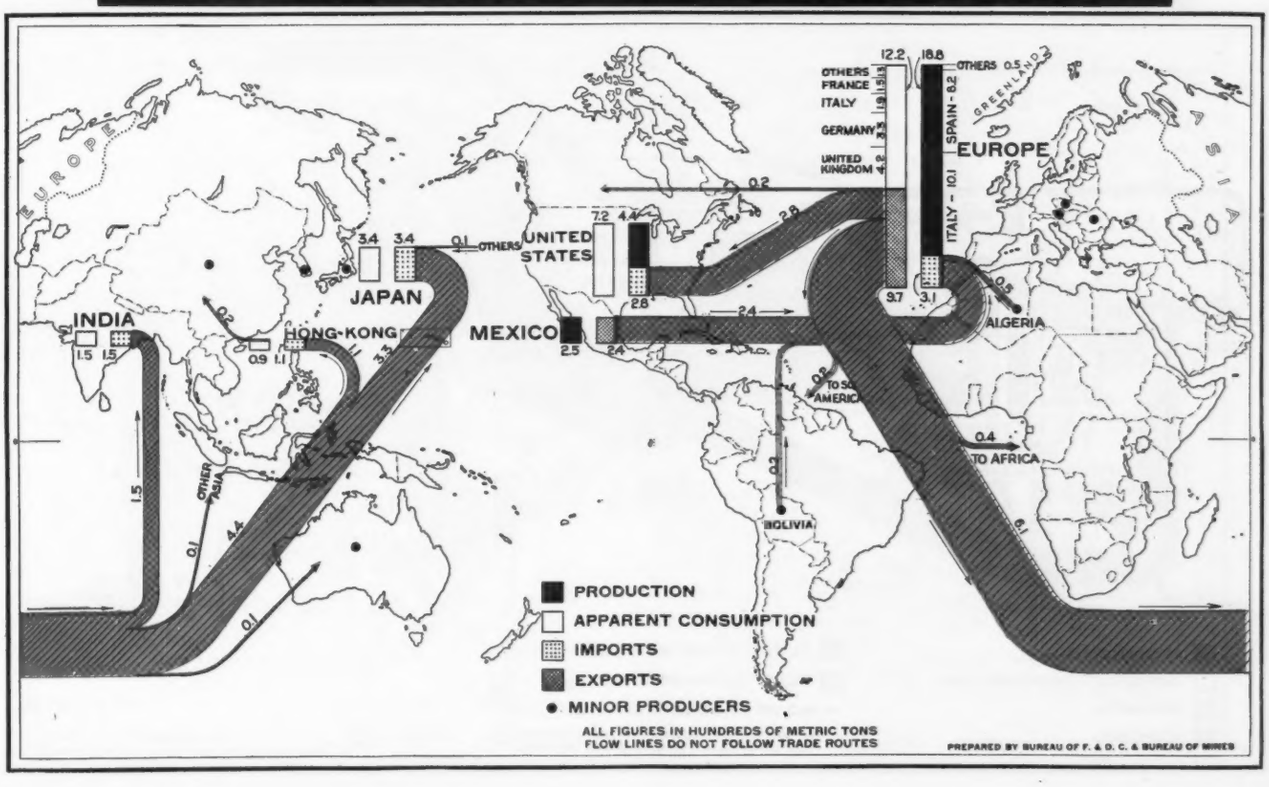
MANGANESE ORE

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



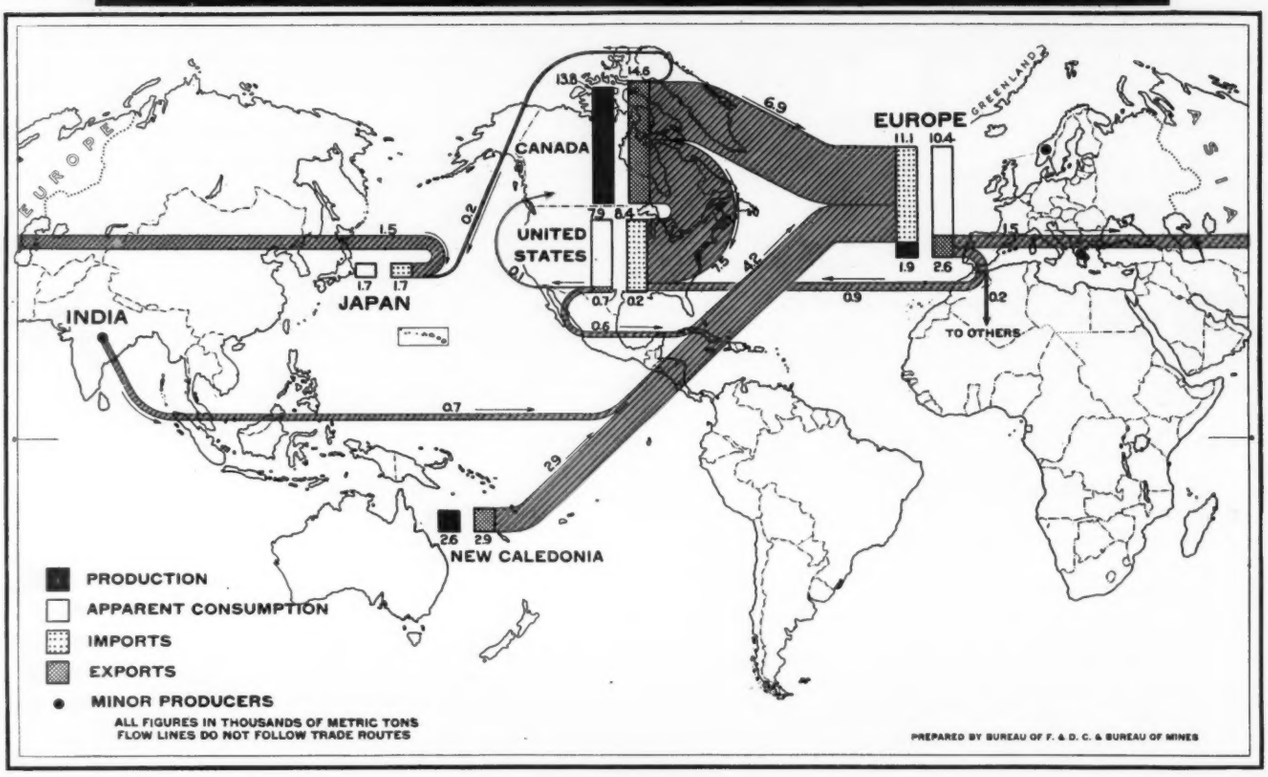
MERCURY

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



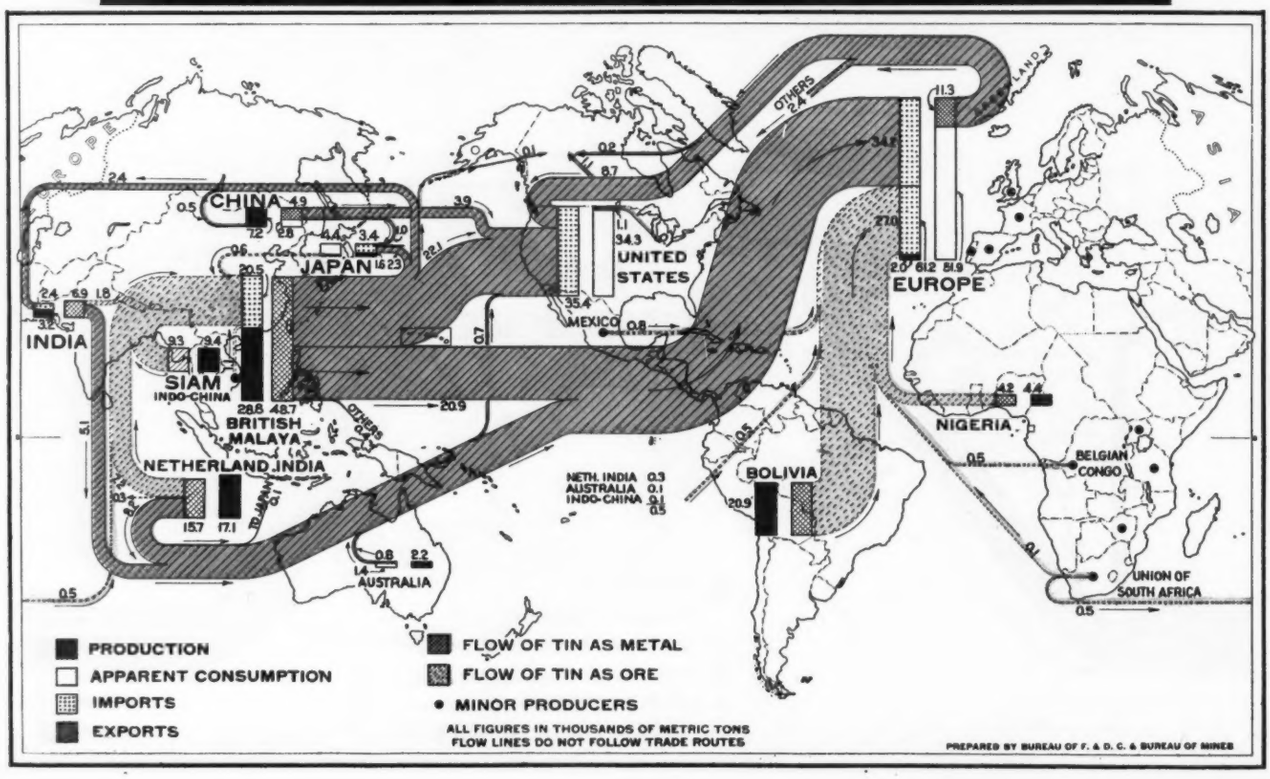
NICKEL

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



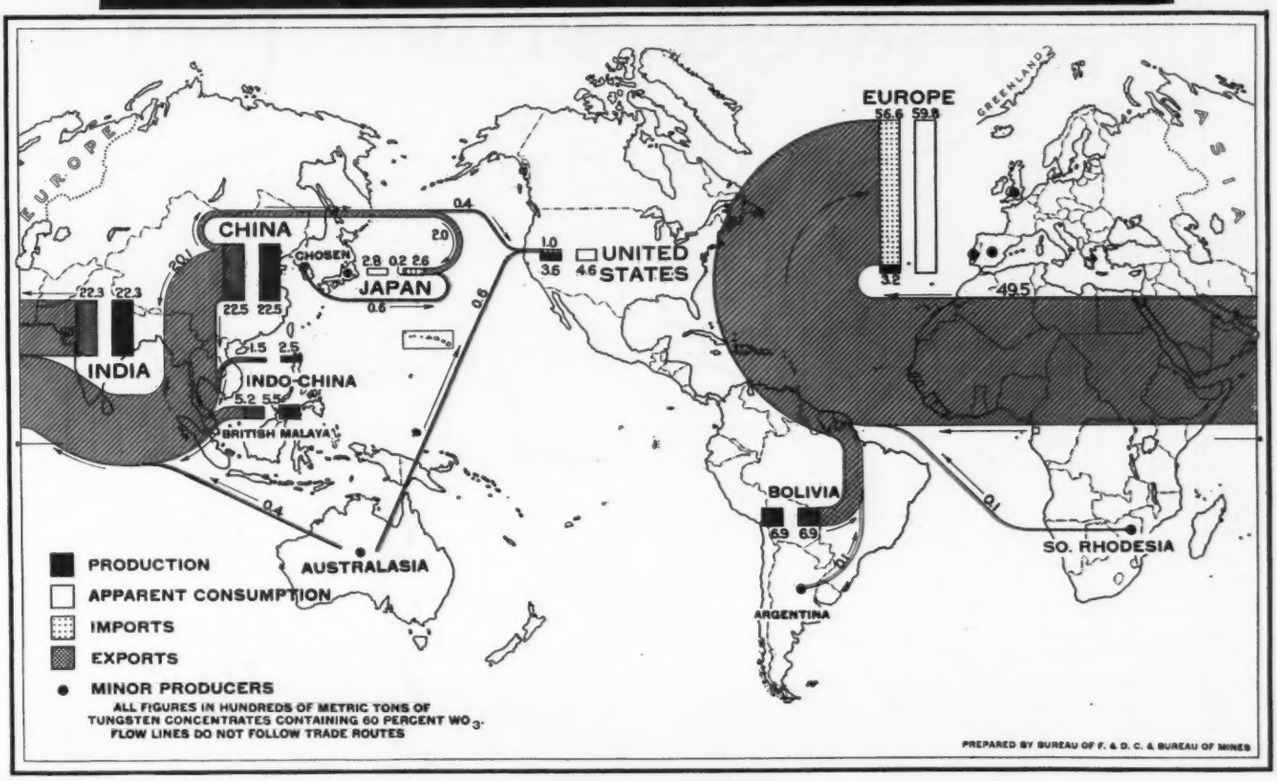
TIN

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



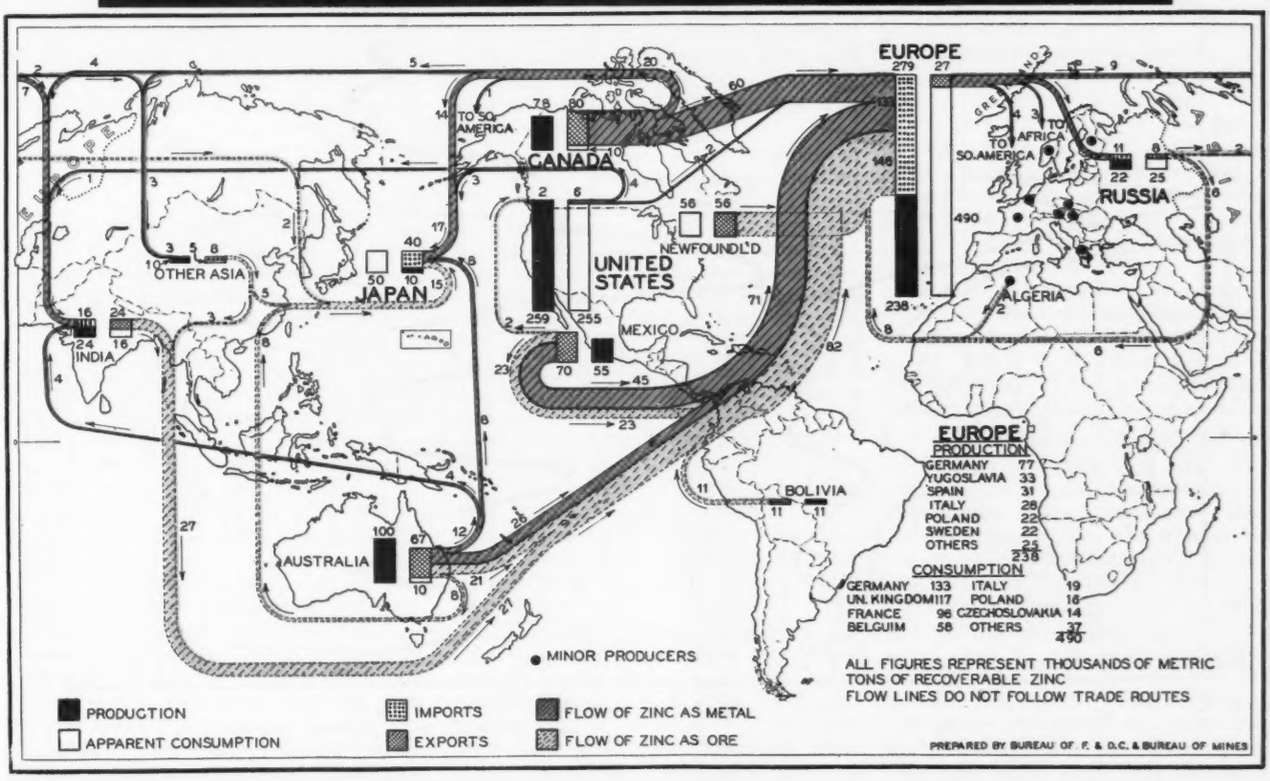
TUNGSTEN ORE

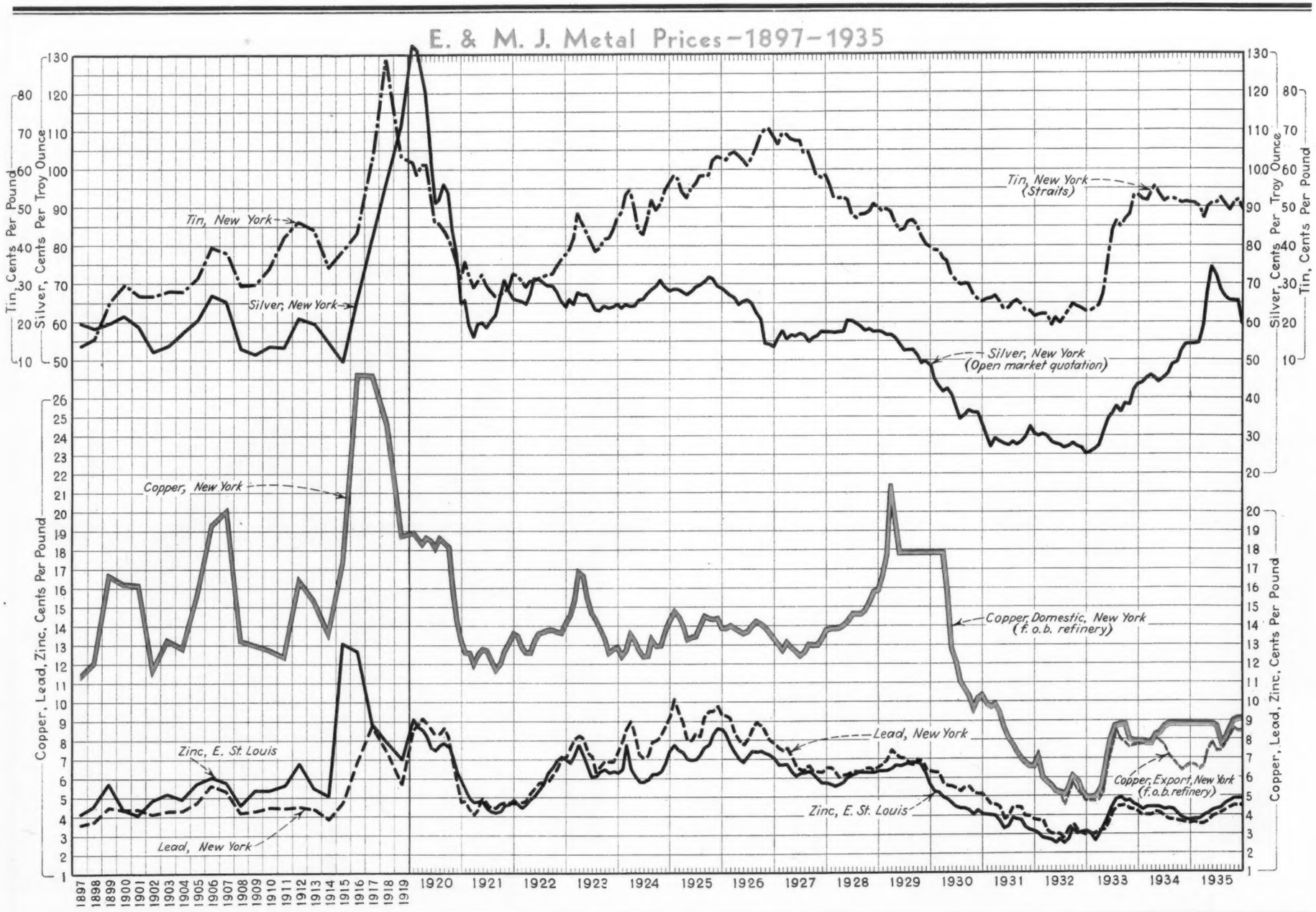
WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932



ZINC

WORLD PRODUCTION, CONSUMPTION, AND PRINCIPAL TRADE RELATIONS, 1932




E. & M. J. Metal Prices—1897–1935
Tin, Cents Per Pound
Silver, Cents Per Troy Ounce
Copper, Lead, Zinc, Cents Per Pound
Tin, New York
Silver, New York
Tin, New York (Straits)
Silver, New York (Open market quotation)
Copper, New York
Copper, Domestic, New York (f. o.b. refinery)
Lead, New York
Zinc, E. St. Louis
Copper, Export, New York (f.o.b. refinery)
1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935

Surveying the Situation

* MEXICO *

The Mining Industry South of the Rio Grande

A picture of existing conditions as seen on a recent visit

A. H. Hubbell
Associate Editor

MEXICAN AFFAIRS today present a picture of prosperity tempered, unfortunately, by a delicate Labor situation. This prosperity has nevertheless attained a degree and an extent sufficient to cause people in the Republic to speak commonly of the "last depression," when referring to the slump in curves and pocketbooks that came upon Mexican business in 1929, as elsewhere, and that still exists in many parts of the United States, if not of the world outside at large. Perhaps this prosperity is the greatest the country has known in years and greater than many citizens there have ever enjoyed, so far as their personal well-being is concerned. Evidence of it is to be found in the increase in Mexico's foreign trade, the steadily mounting exports and imports, with the trade balance normally in the country's favor; the heavy traffic on the National Railways, both freight and passenger, held by some to be a fair barometer; the rise in consumption of electric power; and last, but by no means least, the balance of 19,000,000 pesos over all expenditures remaining in the national treasury on June 30 last.

Several factors have contributed to this prosperity. Among them is the exchange rate, pegged at 3.60 pesos to the dollar ever since the United States went off gold instead of the two-for-one ratio long existing previously. This has stimulated trade, supplied an incentive to manufacture more things in Mexico, and helped companies producing commodities for export. Another factor has been the price of silver, which was high, thanks to Washington's buying policy. To appreciate the effect of this on Mexican economy one has only to note that this metal figures largely in the country's exports and to compare its yearly average price for each of the last ten years with the respective volumes of foreign trade in those years, and thus see how one moves with the other.

The tourist trade—newly found on its present growing scale—is another factor—one which causes joy and pleasant anticipation to general passenger agents, hotel managers, and shop keepers. A fourth factor—and no attempt is made to set these down in the order of their relative influence—has undoubtedly been the program of reform, instituted a decade and a half ago and greatly speeded up in some respects in the past twelve months. Whatever be its merit or its outcome, it has unquestionably put more money into the pockets of the working class in the last few years through wage increases. How long this money stays there and what is done with it are other matters. If spent prodigally by some, it at least gets into circulation.

The mining industry in Mexico has shared in this prosperity, even though at the same time it has seen costs mount disconcertingly. Production of metals has in general improved as compared with 1932 and 1933. Likewise, their prices are higher, especially those of gold and silver. Of even greater benefit has been the profit on exchange that has been realized on metal sales abroad.

Some details as to the metal output will serve to complete the picture. Lead production last year is estimated at a little higher than in 1934, when it scored an advance of 36.6 per cent over the average of 1932 and 1933. Zinc output in 1935 is estimated at about 6½ per cent more than the year before, when it bettered the 1932-33 average by about 26 per cent. Copper also made a better showing, production being 10.6 per cent more than the average for 1932 and 1933. The prices of these metals were somewhat better, although they can stand much more improvement. Due consideration should be given to the fact that producers in Mexico sell on the London basis and the prices they realize, when converted into dollars, are considerably less than those obtaining in the United States markets on the corresponding dates.

The outstanding change is found in the case of the precious metals. While last year's silver output ran about the same as that of the year before, or about 8 per cent more than in 1932 and '33, the price of the metal was much higher than the average of these two years, an average that was distressingly low. And gold brought 75 per cent more than it had for many decades, the output approximating that of 1929.

The scene thus painted is indeed a rosy one, when the additional effect of the depreciation of the peso is considered. But it is intimately linked with the situation in the world of Labor, which we have characterized as delicate.

To call the Labor situation "delicate" is perhaps a euphemious way of expressing the feeling of the business executive who is beset with worries caused by widespread strikes, the seeming insecurity of labor contracts, the growing intractability of groups of workers, the Government's apparent lack of sympathy for him in all these troubles, and, more than all, the uncertainty of the future. The trade unionist and labor agitator undoubtedly think the situation very good. For them the goose hangs high, and while the sun shines they feel they must make hay. But the average

intelligent citizen must be dismayed by the innumerable strikes that have occurred in the year just past and have some uneasiness lest they continue. Lasting prosperity is rarely so created.

To understand what has been going on south of the Rio Grande in recent years one must recall the régime of Porfirio Diaz before the revolution of 1910, when capitalist and property owner received much more consideration, and, if the Mexican was master in his own house, he probably quite failed to appreciate it. Then came the upheaval of 1910, followed by a period of confusion. The year 1917 brought the present Constitution. Gradually the discordant elements got together and formulated a program of much-needed social reform.

Broadly speaking, the objectives of this program have included the raising of wages for the worker and of the standard of living in general, the division of fertile land among the peasants, the correction of illiteracy among the people, the promotion of industry, and the domination of Mexican economy by Mexicans as far as possible. No one will criticize these objectives. The program is socialist, not communist, its spokesmen aver. But, as there are varying degrees and kinds of socialism, so there are differences of opinion in official ranks as to the speed with which reform should be effected and the lengths to which it should go. During the past year the reform machine has been in high gear, so to speak.

Summing up the objectives, the sponsors of the program may be said to seek a controlled capitalist régime under which the individual will live better and have a greater chance to improve himself. The present is a period of transition between what has been and that for which the sponsors hope. If at times there is a haziness of purpose, it should not cause surprise. The reformers are "on their way," a phrase and a situation that ought to be readily understood in the United States. Various parallels of circumstance on the two sides of the Rio Grande suggest themselves. And while the people to the south entered upon their present career long before the spring of 1933, they have since surely received encouragement from what has come to their ears and eyes from across the boundary. Small comfort this to some companies which are trying to operate in the Republic.

Of the objectives of the Government program those having to do with Labor are of greatest moment to the mining industry. Strongly organized, with Government backing and fortified by the National Labor Law, Labor supplies the lever for the Government's greatest effort, that of raising the living standard. This involves, among other things, the raising of wages—individually and the general level—to which end the strike has been found an effective means. Strike procedure—as well as the rights of Labor and the obligations of employers, out of alleged violations of which strikes may spring—is set down in the Labor Law, a lengthy document which has afforded mine, mill, and smelter executives much to think about. The procedure for arbitrating such disputes is likewise prescribed, and if points of law arise, the Supreme Court, in its Labor Section, ultimately decides.

Some of the obligations of employers as stipulated in the Law are significant: To give Mexicans the preference; to prefer those who are syndicalized to those who are not; to provide comfortable hygienic habitations (something that wage increases alone may not necessarily accomplish); to establish elementary schools; to furnish the syndicate with quarters; to deduct syndical quotas requested and proved by unions, as well as dues for societies run by unions.

The Aztec Calendar

Labor is free to organize, as are the employers also, under the Labor Law. No restrictions are placed on the number of unions, or syndicates, that may be formed. In the mining industry, the largest and most important union today is the Syndicate of Mining and Metallurgical Workers of the Mexican Republic—known also colloquially as the Pachuca union, and of great present influence. Besides it, there are perhaps twenty other bodies, mostly small and mainly of local importance. Company unions are practically unknown. The Crom (the Regional Mexican Labor Federation), so prominent ten years ago, has, for the time being at least, passed into relative obscurity.

Under the Law, a collective agreement or contract must be drawn between a company and its employees. Where more than one union is represented among the latter, that with the largest number of employees on its rolls is dealt with in drawing up the contract, which when effective becomes binding upon each employee. This agreement stipulates the wage rates to be paid, minimum salaries, hours of work, nature of work, and rest and vacation periods. Hiring is done by the union. Workmen can be discharged only in strict accordance with the provisions of the Law.

Collective contracts, when once agreed to, are supposed to bind both parties for a two-year period. Amendment can be asked by either party, however, provided it subjects itself to procedure stipulated in the Law and can show that the revision asked is justified. A change in economic conditions, such as a material change in the price of silver, has been held to be such justification.

To hear labor disputes or pleas for the revision of existing contracts, and to consider related questions, the Labor Law provides for setting up boards, so called, of conciliation or arbitration or both. These, broadly speaking, are of three kinds—local or municipal, central or State, and Federal. Such a board, so far as the mining industry is ever concerned, is composed of three representatives, one of the workers, one of the employer, and one of the Government, Municipal, State, or Federal as the case may be, the Government representative presiding at meetings. Government in Mexico today being invariably pro-Labor, it follows that its representative is similarly minded, so that of a committee of three, two of the members will be found speaking for Labor. Under such circumstances the latter's interests are certainly not neglected.

A word as to procedure when a strike occurs. The first point to be decided is its legality. On this the Government rules. If legal, each striker—and that means everybody, for everybody must cease work in a legal strike—becomes entitled to full pay for the period of the strike, no matter how the dispute which caused the strike may be subsequently decided. And a company may not shut down, save with the Government's permission, irrespective of how burdensome or financially disastrous it may be to continue running. A shutdown in defiance of the Government may lead to confiscation and other penalties.

More than these few details as to the curiosities of the Labor Law would be burdensome at this point. The reader who wishes fuller information should read the Law. Enough has been said to show that the interests of the worker have been amply safeguarded, and the problems of operation much increased.

As might be expected, under such favorable conditions, strikes have been numerous throughout industry, especially in the mining industry during the last twelve months. And if Labor has had success in getting what it wants, one must remember that the Government is avowedly for it and that this attitude inevitably extends upward to the Supreme Court, whose members are now appointed by the Government and not for life. Despite the influence of Labor in such high circles, it is paradoxically not in politics, in the sense that there is

no Labor Party, nor has Labor, as such, a platform. Actually Labor has been a minority—the agrarian has been the dominant element in the Republic—but Labor has many friends in the Senate and among the Deputies and outside, who are eager to help it under the existing circumstances. Hence its strength and Capital's concern.

The demands made by Labor upon the mining industry have been varied, at times almost fantastic. They have ranged from requests for big increases in wages and erection of schools, hospitals, and dwellings for the workers to payment for rest days and to having some of the bosses fired, usually comprising all of these, with others of a miscellaneous sort. It would seem at times as if an effort were being made to satisfy all aspirations of a group of workers at a single stroke. But, then, the full demands are not always granted.

As to hours of work, under the Law, all labor done between 6 a.m. and 8 p.m. is classed as day work, and that between 8 p.m. and 6 a.m. is night work. A day shift is 8 hours long, a night shift 7 hours, and a "mixed" shift (part day and part night, as the afternoon shift) 7½ hours. All time of work required beyond these amounts is classed as overtime, and the workman must be paid accordingly.

Wage scales are supposedly based on so-called legal minimum wages for the various districts, established by the local Minimum Wage Board. The legal minimum is the least that may be paid for any kind of labor in any occupation in the district. It ranges from a peso a day in some mining areas to two and a half and three pesos in some others. The reader should bear in mind that these minimum rates do not represent the wages actually paid but merely the lowest that may legally be paid. As a matter of fact, the actual minimum paid by the principal mining companies is two to three times the legal figure, and this for only the lowest class of work. Another fact to remember is that in every case the legal minimum is set by a local board of citizens, familiar with the cost of living in their district, after studying conditions, and is supposedly a "living" wage. One also must not ignore the fact that in general it costs less to live in Mexico, and in some parts much less, than in the United States. If one is to start comparing the lot of the worker in the Republic with that of workers in other countries, it would be fairer to select Europe, where the worker in general does not begin to have what the American workman is supposed to enjoy; or one might compare the worker's status in Mexico with that of the worker in the Central American countries on the one hand and in the United States on the other. As one engineer has put it, both a foresight and a backsight are proper in any survey.

As a result, directly or indirectly, of the Labor program, wages paid by mining companies in 1935 were approximately 40 per cent higher in the lower brackets than in the year before, when the average paid for all classes of labor was 1,204.91 pesos per individual for the year. The percentage increase was somewhat less for workers receiving the higher wages. The increase in the last two or three years is even larger. In addition, the reader should note that the worker has rest days on Sundays, annual vacations with pay, and several holidays with pay during the year; also that wages paid by the mining companies are higher than in other lines of industry.

Unfortunately for the operator, at the same time that wages have been going up the efficiency of labor is said to have been going down. No remedy is available, for the power of discharge has been curtailed drastically and discipline has suffered greatly. Obviously, this results in a further actual increase in the unit cost of labor to the operator and is perhaps even worse in its portent than the wage demands themselves.

In addition to paying higher wages, many mining companies have found it necessary to make new or increased outlays for the erection of houses for the workmen and their families; for providing change houses at mines, so that a man may go home clean, and other facilities for increasing the comfort of the men. Also they are erecting schools, and equipping and maintaining them.

All in all, these changes and innovations have added materially to costs. Taxation aside, it has already become much more expensive than formerly for a mining company to operate in Mexico.

Taxation, previously no inconsiderable burden, has seen increases within the last year. It is of varied kinds. Taxes peculiar to mining include the tax on production, that on the pertenencia (claim) or surface, and the tax on mills and treatment plants. General taxes, to which mining is also subject, include the income tax; the stamp tax on commercial transactions; the railroad gross-earnings tax to be paid by all who transport goods or travel on the railways; taxes on houses and other buildings, lands, and other property not used directly for mining purposes; the absenteeism tax; and municipal taxes. The tax on production is greater than all the others put together, amounting to as much as 75 or 80 per cent of the total.

Tax rates on production vary with the metal produced. In the table below the rates for the major metals are presented, as fixed by the Finance Department for January, 1936. They combine the production tax levied by the Federal Government and that formerly collected directly by the States.

In the case of silver, a special decree issued last April established a sliding scale that bore down heavily as the price rose above 65c. an ounce (U. S. currency). The drastic nature of this new taxation may be seen from the fact that while a price of $1 per ounce would have netted the producer about 71c. after deduction of the tax, a price of $1.29 per ounce would have brought him only about 5c. more. Discussion of this phase of the subject, however, now that the price has declined so severely and the future of the metal is so obscure, would be academic and hardly worth while, save to point out that the increase in taxation undoubtedly served to check new investment in silver-mining projects and killed the boom that began to manifest itself early in 1935. Whether this result is good or bad, all things considered, the reader himself may judge in the light of his views on silver economics.

Production Tax on Metals, Percentages and Rates, Mexican Currency

Form	Gold		Silver		Copper		Lead		Zinc	
	Per Cent	Rate Per Kg., Cents	Per Cent	Rate Per Kg., Cents	Per Cent	Rate Per Kg., Cents	Per Cent	Rate Per Kg., Cents	Per Cent	Rate Per Kg., Cents
In crude ores	10.5	(a)	13.0	8.79	2.8	1.88	3.7	1.332	2.4	1.008
In concentrates	10.0	(a)	12.0	8.11	2.3	1.54	3.2	1.152	1.4	0.588
In precipitates or bars alloyed with other metals	9.25	(a)	11.0 (b)	7.44 (b)	1.8 (c)	1.21 (c)	2.7 (d)	0.972 (d)	1.1 (d)	0.462 (d)
Refined	9.00	(a)	10.0	6.76	1.3	0.87	1.7	0.612	0.9	0.378

(a) Production tax on gold and 10 per cent additional tax applicable to it, must be paid in specie. (b) In precipitates or in bars. (c) In matte or bars alloyed with other metals. (d) In bars alloyed with other metals.

Although the subject is only partly related to taxation, one should also note that the advancing price of silver, when the advance was on, and the continuance of the price at a relatively high level, was a factor in spurring Labor and its supporters in making new and increased demands upon employers. However burdensome these exactions may have proved before the recent break in the metal's price, certainly they will now be felt much more severely wherever silver has been providing a material part of a mining company's revenue. Many a company weathered the low silver prices of the depth of depression only by selecting its better-grade ores for mining and by curtailing exploration work. Today, as a result, some have only the poorer ores remaining and must resume their exploration or increase its scale if they are to keep their mills running.

As to the other taxes, the Income Tax Law, in the schedules for the three principal classifications made, prescribes maximum rates of 12.3 per cent (Com-

merce, Agriculture, Industry), 16.3 per cent (Interest-Industrial Leases), and 20.3 per cent (Participation or Royalties on Government Concessions). In the first group, all legitimate expenses may be deducted, plus depreciation at 5 per cent. Deduction may also be made on industrial leases, in the second group, but no other.

The claim tax, for tracts of 100 hectares or more in size, is 18 pesos per pertenencia, plus 10 per cent—a total of 19.80 pesos annually. Mills and treatment plants are subject to a State tax of 5 per thousand, plus 15 per cent of this as Federal tax, a total of 5.75 per thousand, levied on original cost. The timbre or stamp tax is of many kinds, mostly minor, aside from the Federal sales tax, amounting to 0.55 per cent on gross sales. Chihuahua has a State sales tax, however, of 2.87½ per cent on the gross. The railroad gross income tax is 10 per cent, levied on all freight and passenger traffic, plus a timbre tax of 2.2 per cent. The absentee tax is levied on money sent out of the country, the rates, generally speaking, being 2 per cent on profits from transactions and 4 per cent on investments made abroad. In addition there are state and municipal taxes which vary widely.

Among the expenses attendant upon mining undertakings in Mexico is the tariff on machinery. This amounts to 4 centavos per gross kilogram on such items, for example, as crushers, grinding mills, screens, and hoists, when electrically operated and weighing more than 100 kg., and 5 centavos when they weigh less than this. Likewise on diesel engines, weighing over 100 kg., the rate is 5 centavos, and 6 centavos when the weight is less than 100 kg. As result of the stimulus given to manufacturing by the depreciation of the peso in terms of the dollar, it is beginning to be possible to buy equipment made within the country that formerly had to be imported. How far this trend will go will depend on the future of exchange.

That it must be getting more expensive to operate a mine in Mexico is evident from the foregoing, the increase being mainly due to the higher cost of labor, directly and indirectly. To meet such a situation the logical remedy is to mechanize operations as far as possible. In some cases this has already been accomplished, particularly in mine haulage and to a less extent in mucking. Certainly possibilities must remain, for much work is still done manually in the mines of Mexico, and likewise in the mills and smelters. Mechanization, however, calls for some mechanical skill on the part of those who work with the equipment, and, more than this, for men who through education and long experience are able to direct such work and keep it running smoothly. Such men are hard to find. And, finally, mechanization necessitates additional investment, a deterrent today in Mexico in view of the existing uncertainty as to the future.

This uncertainty springs naturally from the Government's aforesaid haziness of purpose, as expressed, and from the ignorance of operators as to how far the Government intends to let Labor pursue its present course. The mere fact that in any conference on Labor's relations with employers two conferees out of three are avowedly pro-Labor before the conference even starts is enough to wreck confidence in the future. And this lack of confidence—this fear—must be surely on the increase, as Labor goes ahead heedless of everything save what it holds to be its rights. Inevitably in every mind these questions must present themselves: Is Labor to go just so far and then be checked? Or, can it be checked, if and when the moment for checking comes? And, if it cannot be checked, what then?

As to the last question, there are interesting possibilities. An enterprise that is forced by law into a losing position, and yet cannot legally shut down, is virtually subject to a degree of confiscation. And, in Mexico today, if it cease work in defiance of the law, it is liable to confiscation. The question therefore arises, is Labor to be allowed to push Capital on to the horns of this dilemma? This is hardly believable, in view of the assurances given foreign mining companies in the past that their interests would be safeguarded if only they subjected themselves to the law of the land.

Further, the talk of "nationalizing" the mining industry, the while that no one knows what "nationalization" means, contributes to the uncertainty of the future. Perhaps this policy is largely on paper and will remain so. Who so foolish as to think that the Government could reunite capital, experience, and other elements essential to the conduct of the mining business? But where there is talk, action may follow, and the possibility is a stumbling block. And so the puzzling question as to what may happen if Labor cannot be checked remains unanswered on this and other counts. The Government would do well to clarify convincingly its position.

The same uncertainty which deters those mining companies which are already producing, and perhaps have long been in the production stage, from investing further money is also acting to curb the entry of new capital into the country for the purpose of engaging in new mining ventures that involve large expenditures. Here, again, what else would one expect? And yet, even while strike is succeeded by strike, accompanied by every conceivable demand, the Government naïvely beckons with an inviting finger to the investor. Small wonder if the latter, where mining is concerned, concludes that the great risk normal to the business is quite sufficient without adding a new one to it.

Although it is often pointed out that mining capital invested in Mexico is largely foreign, the fact is generally overlooked that the great majority of mining claims that are in private hands in the Republic, and in which the industry's hope for the future chiefly lies, are held by Mexicans, generally by virtue of location or "denouncement" and payment of the claim tax. In contrast, it is mostly through purchase that outside capital has acquired its present properties, such transactions having frequently involved the payment of handsome sums. And if such investments have subsequently been made to pay, due credit should be given to the venturers, not only for their willingness to incur the risk and wait for profits but for their appreciation of the fact that the highest degree of technical skill and knowledge is necessary to the success of the average mining enterprise today.

Popocatepetl—the Mountain that Smokes

* UNITED STATES *
Mining Revives

Greater activity results from rise in metal prices caused by growth of demand as industry recovers

H. C. Chellson
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THE BEGINNING of a general industrial recovery in 1935 created a demand for base metals that stimulated mining activity in many mining regions of the country. Gold production continually increased. Central and Eastern states as well as those in the West witnessed the reopening of mines closed for many years. The high price of domestic newly mined silver increased employment for mine rehabilitation and construction and improvement of many mills, and expanded mine operations.

Trends during the first six months indicated that industrial recovery was gaining slowly but steadily, and a lukewarm optimistic attitude was apparently stimulating greater confidence. As a result, copper, lead, and zinc mines were dewatered; old mines were examined; ore and tailings dumps were sampled; shafts and hoisting equipment were checked and made ready; mine development was planned and started. Flotation plants were enlarged and modernized and smelters reopened to clean up accumulated stockpiles. In the midst of improving conditions the Supreme Court outlawed the NRA on May 27. Metal prices became somewhat irregular in the general uncertainty which followed, but they strengthened to higher levels during the summer months. Employment increased only to be followed by a rash of strikes which broke out in several mining states. Labor unions demanded recognition and higher wages, but strikes were settled and miners' earnings increased. Private capital came into the mining states through companies seeking funds for mine development and exploitation. From Oct. 1, 1934, to Dec. 1, 1935, 45 mining companies registered under the Securities Act and were released by the Securities and Exchange Commission to sell shares to the public. Sales were expected to net around $12,400,000 for mine development, exploitation, construction of mills, and new equipment. During the year the Reconstruction Finance Corporation approved loans totaling $6,712,000 to 21 mining companies. Of this amount $1,212,000 has been so far disbursed among seven of the applicants.

At the beginning of the third quarter confidence was reasonably established in the fact that recovery was probably on a sound footing and would go forward. This confidence encouraged opening of some large copper mines long shut down. Zinc mines throughout the country intensified operations. Numerous precious-metal mines with preliminary work completed started operations.

The Bureau of Labor Statistics figures show that from October, 1934, to October, 1935, employment in the metalliferous mining industry as a whole increased 19.2 per cent, 37.2 per cent was the increase for payrolls, and the increase in per capita weekly earnings for this period was 15.2 per cent.

ARIZONA • The production of recoverable gold in Arizona during 1935 was 226,500 oz., compared with 167,024 oz. in 1934. The principal producers were the Copper Queen Branch of the Phelps Dodge Corporation, at Bisbee; the United Verde, at Jerome; New Cornelia mine, at Ajo; Superior & Arizona Lease, at Superior; and the Tom Reed, at Oatman. Tombstone belied its name when new orebodies were found in the Empire mine, controlled by Tombstone Development, and in the Toughnut mine, operated by United States Smelting, Refining & Mining Company. Many small mills and cyanide plants were completed during 1935 and their output increased production during the year, such as the 100-ton flotation plant at the Octave mine, the Tom Reed mill, and Pioneer Gold mill at the Plymouth mine. A gold discovery in the White Tank Mountain district near Buckeye created prospecting interest.

The silver production during 1935 was 6,375,000 oz., which showed a marked increase over the 4,448,474 oz. produced in 1934. The principal producers of the metal were the Copper Queen mine, at Bisbee; the Magma mine, at Superior; United Verde, at Clemenceau, and New Cornelia mine, at Ajo. Silver was also produced in the Tombstone district and from the lead-zinc ore in the Montana mine, at Ruby.

The increased demand for copper resulted in reopening the Inspiration mine, at Inspiration, and a 25 per cent production increase at the properties of the Phelps Dodge Corporation. United Verde Extention operated intermittently in filling up the ore bins, then smelting the ore at Clemenceau. Phelps Dodge Corporation acquired the United Verde Copper property early in the year and reopened the mine in part, thereby becoming the second largest copper producer in the country. The Miami smelter was reopened during March for the first time in three years to smelt accumulated stockpiles.

The chief producer of lead and zinc in Arizona is the Eagle-Picher Mining & Smelting Company, operating the Montana group of mines at Ruby. The company's 300-ton flotation plant resumed operation in August, 1934, and has been in operation ever since. Eagle-Picher also increased its holdings by purchasing an additional group of twelve claims near its present property.

Mining activity increased in all districts throughout the State. Rising metal prices encouraged production, and labor strikes. On June 10 the International Mine, Mill and Smelter Workers Union struck at the Copper Queen for union recognition, but only 72 of the 1,100 men failed to report for work. On July 1 a strike occurred in the Oatman district for higher wages and union recognition. The men agreed to return to work at their old wage scale up to Jan. 1, 1937, unless there is a change in the present price of $35 an ounce for gold. Employment in Arizona's mining industry totaled about 5,400 men at the close of 1935.

CALIFORNIA • Gold produced in California during 1935 continued the greatest of any state in the Union, being 869,400 oz., compared with 719,064 oz. in 1934, or a little more than a 21 per cent increase for the year. The principal producing counties were Nevada and Sacramento, followed by Amador, Yuba, Eldorado, Calaveras, Sierra, and Kern counties. The outstanding event of the year in domestic gold mining was the development of the high-grade strike discovered in 1933 at the Silver Queen (now Golden Queen, Goldfields American Development Company) near Mojave. The orebody developed for 700 ft. on the 200-ft. level had an average width of 14 ft. and an average value of $30 per ton. The 300-ton cyanide mill started treating ore toward the end of the year. Beebe Gold Mining passed to Alaska Juneau in the first quarter and later erected a 400-ton mill. The Anglo-American Corporation erected a 1,100-ton cyanide plant to treat the tailing from the Yellow Aster mine, at Randsburg. New dredges of bucket type and dragline were placed in operation in the Salisbury, Loomis, and Folsom areas. Newmont Mining Company conducted an extensive program in the Kern River area, and Yuba Consolidated started a three-year $2,500,000 gold-development program in central and northern California. The Mother Lode was active, with rehabilitation of old mines and construction of new cyanide and flotation plants. Lava Cap deepened its shaft from 1,200 ft. to 1,600 ft., and is now sinking to 1,800 ft.

Production of silver increased from 844,413 oz. in 1934 to 1,117,700 oz. in 1935, or about a 30 per cent increase, which is interesting to compare with the 110 per cent increase between 1933 and 1934. Silver occurs in gold ores in the Nevada City-Grass Valley districts, where most of the State's silver is produced. The Golden Queen mine, in Mojave district, also produces silver, but the

Lava Cap Gold Mining Corporation was the largest silver producer.

Copper production in 1935 was 1,276 tons of metal, compared with 412 tons in 1934. The reopening of the Walker Copper Mine during October after a three-year shutdown made it possible to treat about 125,000 tons of copper ore in the company's flotation plant during 1935.

The major production of lead and zinc came from Inyo County.

There were strikes in the Argonaut and Kennedy mines and at the Selby Smelter. During the year the Argonaut Mining Company started to modernize the mill and replace stamps by flotation. The California gold-mining industry was aroused by a severance tax proposed by the State Legislature, but no definite law concerning this was enacted.

Eagle County accounted for 87 per cent of the State's copper production. Producing mines included Alligator, Ben Butler, Ground Hog, Pine Martin, Star of the West, and Tip Top.

Leadville, in Lake County, continued as chief lead producer of Colorado, totaling 2,410,000 lb., with San Juan County producing 2,337,000 lb. Zinc production was 2,027,000 lb., of which more than half came from mines in Lake County. The Climax Molybdenum Company operated its flotation mill throughout the year at a rate of 3,500 tons daily.

IDAHO • In contradistinction to other Western states, Idaho's gold production decreased in 1935, as 83,800 oz. were produced, compared to 84,817 oz. in 1934. Gold-dredging operation increased, however, and produced 23,850 oz., against 15,852 oz. in 1934. Smaller placer operation decreased during the year. Gold production from lode mines also decreased.

The major producers of gold were the Boise-Rochester mines, in Elmore County; Yellow Pine Company, Idaho Gold Dredging Company, Warren Creek Dredging Company, and Gold Hill mine, at Quartzburg.

Idaho is the premier silver State, producing 10,150,000 oz. in 1935, compared to 7,394,143 oz. in 1934. The Sunshine Mining Company, the largest silver producer in the United States, was responsible for more than half of the total production. The company is now sinking a new three-compartment shaft to a depth of 3,100 ft., and general preparations are under way to produce 6,000,000 oz. of silver annually. Other mines in the "dry-ore" silver belt, such as Bunker Hill & Sullivan, Hecla, Morning, and Crescent, were substantial silver producers. Many old mines were rehabilitated and milling facilities increased. Developments in the Polaris mine during 1935 indicate another silver producer will be added to the list in 1936.

Idaho production of copper comes principally from the silver mines in Shoshone County, and the State's largest producer of copper is the Sunshine Mining Company.

Idaho is second in lead production, and the following mines produced most of the metal during 1935, amounting to about 76,400 tons of lead: the Bunker Hill & Sullivan, Hecla, Morning, Page, Golconda, Gold Hunter, Blackhawk, and Frisco mines.

The production of zinc in 1935 was 29,800 tons, most of which came from the Morning mine of the Federal Mining & Smelting Company, followed by Bunker Hill & Sullivan mines. Demand for zinc in 1935 increased, and the Star Mine and the Sidney, both closed for several years, were reopened. The use of High Grade zinc for die casting, principally in the automobile industry, has demanded greater production of this grade of zinc.

United States Mine Production of Gold, Silver, Copper, Lead, and Zinc

(United States Bureau of Mines)

Mine production of metals in 1934 and 1935 in terms of the recovered and recoverable metal in oz. and short tons. 1935 estimated.

	Gold, Oz.		Silver, Oz.		Copper, Tons		Lead, Tons		Zinc, Tons	
Western States:	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935
Arizona	167,024	226,500	4,448,474	6,375,000	89,041	135,250	3,438	7,650	905	3,290
California	719,064	869,400	844,413	1,117,700	285	1,280	412	690	361	120
Colorado	324,923	351,347	3,475,661	4,605,845	5,647	7,170	4,218	5,370	772	1,013
Idaho	84,817	83,800	7,394,143	10,150,000	766	1,050	71,324	76,400	24,799	29,800
Montana	97,446	147,850	4,006,468	9,370,000	31,633	77,945	10,005	15,825	30,721	53,820
Nevada	144,275	178,800	3,057,114	4,280,000	20,806	35,010	10,991	12,740	13,940	15,230
New Mexico	27,307	33,560	1,061,775	1,052,900	11,815	2,520	9,365	7,690	26,522	22,420
Oregon	33,712	51,800	46,562	112,000	19	200	21	24	37	5
South Dakota	486,119	569,222	99,741	141,806	.....	.....	.....	.....	.....	.....
Texas	359	622	854,442	976,000	15	17	360	560	.....	.....
Utah	136,581	184,950	7,111,417	9,133,900	43,012	64,210	58,077	64,090	28,198	31,930
Washington	8,302	9,900	44,120	50,900	7	50	291	90	1,926	1
Wyoming	4,871	4,112	710	793	2	1	1	3	.....	.....
Central States:										
Arkansas	.....	.....	.....	.....	.....	.....	40	35	68	80
Illinois	.....	.....	310	3,147	.....	.....	40	440	.....	.....
Kansas	.....	.....	.....	.....	.....	.....	6,805	11,270	38,261	49,280
Kentucky	.....	.....	.....	.....	.....	.....	104	70	125	65
Michigan	59	.....	529	.....	24,108	30,990	.....	.....	.....	.....
Missouri	.....	.....	63,066	101,024	23	.....	90,493	97,520	7,059	7,470
Oklahoma	.....	.....	.....	.....	.....	.....	16,747	24,260	107,772	133,600
Wisconsin	.....	.....	.....	.....	.....	.....	234	285	9,807	8,765
Eastern States	6,646	7,465	104,493	88,364	10,167	10,025	3,625	4,960	147,453	160,130
Alaska	537,282	454,226	168,868	159,295	61	3,800	840	700	.....	.....
Total	2,778,786	3,173,554	33,251,787	47,718,674	237,407	369,520	287,432	330,680	438,726	517,020

COLORADO • Metal mining in Colorado increased steadily during 1935. The gold production, according to Bureau of Mines report, is estimated at about 351,347 oz. This is an increase of 29,607 oz. over the record for 1934. Placer operations using power shovels and dragline excavators were greater in 1935, but individual small-scale placer operations were less. Most of the Cripple Creek production was treated at the Golden Cycle 1,500-ton custom mill at Colorado Springs. The new 450-ton flotation section of the mill was completed in February. Cripple Creek Milling Company completed in December a new 800-ton flotation-roasting-cyanidation custom mill on the property of the Stratton Estate. Shipping and dump ore in Cripple Creek lessened during 1935, whereas underground repairs and development increased, and indications point to greater mine production.

Colorado produced 4,605,845 oz. of silver in 1935, compared to 3,475,661 in 1934. Eagle County was the principal producer, having 2,766,556 oz., or more than half the total. The Eagle mine of the Empire Zinc Company was the important silver producer. The Creede district, in Mineral County, followed, with 476,977 oz.

MONTANA • Montana increased its gold production by 40 per cent in 1935, netting 147,850 oz., against 97,446 oz. in 1934. Lode mines increased output in the Bannack, Bever, and Cedar Plains districts. Montana Consolidated, near Helena, produced gold-quartz ore.

Silver production in 1935 amounted to 9,370,000 oz. against 4,006,468 oz. in 1934. A higher silver price stimulated production, and old mines in the Philipsburg, Butte, and Neihart districts were reopened. Most of the silver produced, however, came from copper ores mined by Anaconda Copper.

Practically all the copper produced in Montana came from the Butte mines of Anaconda Copper.

Lead production was 15,825 tons of metal in 1935. Anaconda Copper's mines, especially the Orphan Girl, continued to be the principal producers.

The major production of zinc is from mines in the Butte district.

NEVADA • Production of gold in this state during 1935 was 178,800 oz., compared to 144,275 in 1934. Cyanide and flotation mills were built in the Como district, on the Comstock Lode, and in the Weepah and Pioche districts. The

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* CANADA *

Dominion's Gold Production Breaks All Records

Producers number 115, with prospect of 41 more this year . . . Increases were recorded in other metals and in non-metallics also

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CANADA'S gold production in 1935 reached an all-time record, and there was a decided increase last year, also, in most of the metal and non-metallic mineral products of the Dominion. The mining industry now holds a dominant place in the Dominion's national life. Following the recent change to Liberal control of the Federal Government, certain changes in legislation may be made which will affect the mining industry, with possible tax reductions. The Hon. T. A. Crerar, Federal Minister of Mines, announced on Nov. 9 his intention of working for a program comprising stability of policy, confidence of capital, and the removal of tax uncertainty.

Canada's total mineral output in 1935 was valued at $308,164,000, about 2.7 millions lower than the record value attained in 1929, and exceeding 1934 by 11 per cent. Production of gold, nickel, copper, and zinc has never before approached the 1935 figures. The Dominion Bureau of Statistics shows an increase of 14 per cent in the value of metals produced in 1935, and more than half of this figure was derived from the gold-mining industry. The present status of Canada among world metal producers, as listed by the American Bureau of Metal Statistics, is first in nickel, platinum, and asbestos; second in zinc, third in silver and copper, and fourth in gold and lead.

The extent of improved production in 1935 is indicated by the following figures: Copper went up 15.1 per cent and nickel 8 per cent; lead increased 26 per cent in value on a slight decline in quantity; zinc went up 5.9 per cent in quantity and 8.1 per cent in value; gold increased 10.8 per cent in quantity and 13.0 per cent in value; silver was down slightly in quantity but up in value.

Several of the newer products of Canadian mines shared in the general up-trend of the mineral industries as a whole. The Port Hope refinery of Eldorado Gold Mines, Ltd., recovered radium - uranium products from the silver-pitchblende ores of the Great Bear Lake area. More than 100 tons of concentrates was ready for shipment to Port Hope before navigation closed in 1935. It was unofficially reported that products from the refining of 26 tons of ore in 1934 were valued at $210,000, and the Dominion Bureau of Statistics states: "Fifty-eight tons of pitchblende were treated in Canada in 1933 and produced 3,021 mg. of radium, 98 per cent average concentration, and 34,940 lb. of uranium salts."

Commercial production of selenium and tellurium was started in 1931, and an increasing industrial demand is being found for these byproducts of the refining of blister copper, both at Montreal East and Copper Cliff. The reduction plant of the Chromium Mining & Smelting Company, at Sault Ste. Marie, Ont., started operations last year with two electric furnaces. The initial capacity is stated to be 60 to 200 tons of chromium alloys monthly, treating ore mined in northern Ontario.

Canada has become one of the major producers of titaniferous iron ore, with shipments during the first half of 1935 amounting to 2,419 tons, compared with 2,023 tons the year before. Metallic bismuth produced at Trail, B. C., and bismuth metal contained in silver-lead-bismuth bullion exported from the smelter at Delora, Ont., increased in value from $7,340 in 1932 to $301,215 in 1934.

Active demand continued for copper products fabricated in Canada, including wire, rods, and sheets; and the value of blister copper exports increased more than 300 per cent in 1934 over the record for 1933. The total value of copper exported in all forms during the first half of 1935 was in excess of the record for the first six months of 1934 by $12,588,379. The non-ferrous smelting and refining industry advanced 49 per cent in 1934, with prospects for a still better showing in 1935.

In the eleven-year period 1925-35 the production of copper, lead, and zinc has shown a series of remarkable increases which culminate in all-time records for the mining industry in this country and point the way to still further expansion in 1936, stimulated by the stronger tone in world markets. During this period copper advanced from 111,450,518 to 418,753,148 lb.; lead went up from 253,590,578 to 337,459,472 lb.; and zinc production increased from 109,268,511 to 316,250,769 lb.

Nickel production in 1935 was 139,194,348 lb., as compared with 110,000,000 lb. in 1929. Credit for this record is due chiefly to the International Nickel Company of Canada. With ore reserves of more than 200 million tons, the company's holdings of 52,000 acres in the Sudbury district are yet only partly explored. The value of precious metals recovered in 1935 is estimated at close to $10,000,000. Copper sales, amounting to 195,000,000 lb. in 1934, are expected to exceed 220,000,000 lb. in 1935. By the end of 1936 the smelter capacity will be enlarged more than 40 per cent.

Canada holds fourth place among world producers of aluminum. The ore treated by the Aluminum Company of Canada is imported from British Guiana for the ingot works at Arvida, Que., where a new million-dollar refinery is to be ready for operations in March, 1936. A fabricating plant is located at Shawinigan Falls, Que. Aluminum exports for the first eight months of 1935 were valued at $6,016,000.

In addition to the 17 metallic minerals produced in the Dominion, the mining industry embraces 21 non-metallics. These products showed a total increase of 16 per cent in value in 1935 over the preceding year, due principally to better conditions in the asbestos market. Asbestos production amounted to 212,857 tons in 1935, compared with 155,980 tons in 1934. Moderately increased output was registered for graphite, gypsum, iron oxides, mineral waters, salt, and sulphur, but there was a decline in the output of quartz, feldspar, talc, and other non-metallics. Structural materials, except cement, were slightly better in 1935 than the 1934 figures.

An important factor in the up-swing in the total value of Canada's mineral products was the higher price of precious metals. Gold averaged $35.19 in Canadian funds, compared with $34.50 per ounce in 1934 and $28.60 in 1933. Silver averaged 63.03c. per ounce, up from an average of 47.46c. in 1934 and 34.75c. in 1933. A large part of Canada's silver output is now byproduct, the greatest single source in 1935 being the complex ore of the Sullivan mine, in British Columbia. High-grade silver deposits are being developed near Great Bear Lake, and some activity is being revived in the Cobalt district, Ontario, but production from these sources is not expected to affect Canada's output substantially in 1936.

The total silver output for the Dominion in 1935 was 16,413,492 oz., compared with 16,415,282 oz. in 1934.

During the past year the vital problem of mine taxes has been given careful study. When the gold bullion tax was removed on May 31, 1935, some of the features contested by operating companies were removed, but there continued to be widespread opposition to the Federal policy of collecting revenues on gold production. From 1931 to 1934, according to figures compiled by G. C. Bateman, the total direct taxes paid by

Table I—New Canadian Gold Producers Announced for 1936

Mining Property	District	Proposed Mill Capacity
ONTARIO		
Associated Gold Min. & Fin. (Concordia)	Porcupine	20
Bey Mines (Ore Chimney)	Hastings	50
Centennial (L. B. United)	Michipicoten	50
Cole Gold	Red Lake	....
Cordova	Hastings	....
Craig	Hastings	100
Golden Summit	Kirkland Lake	25
Hudson Patricia	Woman Lake	50
Kenora Prospectors (Cedar Island) (*b*)	Lake of Woods	35
Lakeland Gold (Hollinger) (*c*)	Kirkland Lake	30
	Hislop	100
Morris Kirkland Gold	Kirkland Lake	100
Neville Canadian Gold	W. Shining Tree	30
Omega Gold (Castle-Tretheway) (*a*)	Larder Lake	300
Parmour Gold (*e*)	Porcupine	500
Red Crest Gold	Red Lake	25
Red Lake Gold Shore	Red Lake	100
Rich Rock (Golden Fleece) (*d*)	Hastings	25
Shenango Gold	Oba	25
Shreiber Pyramid Gold	Shreiber	50
Sturgeon River Gold	Sturgeon River	....
QUEBEC		
O'Neill Thompson Gold	Joanne	25
Shawkey Gold	Dubuisson	150
Stadacona Rouyn	Rouyn	200
Tiblemont Island	Tiblemont	....
NOVA SCOTIA		
Avon Gold	Oldham	100
Nugold (Blockhouse-Dome)	Lunenburg	....
Richland Gold	Queens	50
ALBERTA		
Peers Placer Gold	McLeod River	1,000 yd.
MANITOBA		
Gunnar Gold	Big Rice Lake	150
Laguna (Rex) (*f*)	Herb Lake	....
BRITISH COLUMBIA		
Abco	Vancouver Is.	50
Bayonne	Nelson	75
Congress Gold	Bridge River	....
Esperanza	Alice Arm	30
Federal Gold	Bridge River	100
Hedley Mascot	Similkameen	150
Taylor-Bridge River	Bridge River	50
Wesko Mines (Centre Star)	Ymir	....
NORTHWEST TERRITORIES		
Athona Gold	Lake Athabaska	15
El Bonanza Mining (*g*)	Great Bear Lake	....

(*a*) Includes Can. Associated and Crown Reserves mines. (*b*) Controlled by Ventures, Ltd. (*c*) 150-ton mill installed in 1933; inactive 1934. (*d*) Formerly produced $10,000; now controlled by Cons. Min. & Smelt. (*e*) Controlled by Noranda Mines. (*g*) Silver ore for treatment in Eldorado mill. (*f*) Controlled by Mining Corporation.

Table II—Canadian Metal Mines Producing in 1935, With Proposed Mill Increases

Mining Property	Approx. Average 1935	Mill Installed or Projected Capacity	Date of First Production
ONTARIO			
Algoma Summit (McCarthy-Webb)	(*l*)	50	1935
Ardeen (Moss Gold)	(*l*)	200	March, 1932
Ashley (*e*)	130	150	Aug., 1932
Barry-Hollinger	100	150	July, 1926
Bidgood Kirkland (*c*)	50	100	July, 1934
Buffalo Ankerite	425	500	June, 1926
Casey Summit (Argosy) (*g*)	(*l*)	100	July, 1934
Central Patricia	100	150	June, 1934
Clark Gold	(*l*)	....	1935
Coniaurum (*j*)	410	500	May, 1928
Darwin Gold (Grace)	(*l*)	60	Nov., 1935
Dikdik (J. B. McMartin)	(*l*)	25	1934
Dome	1,525	1,550	1910
Duport (Cameron Island) (*j*)	(*l*)	25	1935
Gillies Lake-Porcupine	(*l*)	100	1935
Gilmour Gold (*b*)	60	100	Sept., 1935
Halcrow-Swayze (*g*)	(*l*)	25	1935
Harkness-Hays	....	25	Aug., 1935
Hollinger	5,100	6,000	1910
Howey	1,300	1,400	April, 1930
Island Lake Gold (*g*) (#)	50	....	April, 1934
J-M Consol. (Jackson-Manion) (*g*)	(*l*)	25	May, 1934
Kirkland Lake Gold	200	250	1919
Lake Shore	2,300	2,400	1918
Little Long Lac	170	200	Dec., 1934
Macassa	190	200	Oct., 1933
Matachewan Consolidated (Canadian Matachewan) (*j*)	140	200	Nov., 1934
Marbaun (March Gold)	160	300	1926
McIntyre Porcupine	2,400	2,600	1912
McLaren Porcupine	(*l*)	20	July, 1935
McMillan	110	150	Aug., 1934
McKenzie Red Lake	125	200	March, 1935
Minto	95	100	June, 1931
Naybob	(*l*)	50	1935
Northern Empire (Newmont)	125	150	March, 1934
North Shores (Palmer)	(*l*)	75	Sept., 1934
Parkhill	60	100	July, 1931
Paymaster Consolidated	270	500	Oct., 1934
Pickle Crow	160	200	April, 1935
Sol d'Or (Rainbow Lake)	(*l*)	50	1933

Table II Continued—Canadian Metal Mines Production

ONTARIO, Continued				
St. Anthony	150	200	Aug.,	1934
Sylvanite	425	450	July,	1927
Tashota Goldfields (*v*)	60	75		1935
Teck-Hughes	1,175	1,250		1917
Toburn	100	100		1913
Vipond (Anglo-Huronian)	300	300		1911
Wright-Hargreaves	1,000	1,000	May,	1921
Young-Davidson	600	800	Sept.,	1934
Falconbridge Nickel (*j*)	450	800		
International Nickel	8,000	12,000		
M. J. O'Brien (Cobalt) (*t*)	(*l*)	250		
M. J. O'Brien (Gowganda) (*t*)	(*l*)	80		
Chromium Mining & Smelting	(*l*)	....		1935
QUEBEC				
Amtfield	165	180	Aug.,	1935
Beattie (*j*)	1,000	1,400	May,	1933
Bussieres (Treadwell Yukon)	(*g*)	190		1932
Canadian Malartic (*j*)	160	300	April,	1935
Granda	160	500	June,	1930
Greene Stabell (*a*)	70	100	Dec.,	1933
Lamaque (Teck-Hughes)	250	500	April,	1935
McWatters	70	150	Sept.,	1934
Noranda Mines (*a*)	5,000	5,500	Dec.,	1927
O'Brien Cadillac	(*l*)	150	Sept.,	1932
Perron (Mathews)	25	125		1933
Siscoe Gold	415	450	Jan.,	1929
Sullivan Cons.	100	150	May,	1934
Tetreault (*u*)	(*l*)	500		1913
Thompson Cadillac (*g*)	....	150		1934
NOVA SCOTIA				
Banook Mines	....	25	May,	1934
Beacon Gold	10	20	Nov.,	1934
Caribou (*r*)	20	20		1934
Guysborough Mines (*j*)	50	100		1934
Higgins & Lawlor (Moose River)	(*l*)	15		1934
Lacey (Gold River)	30	35		1934
MacDonald Hudson Gold	(*l*)	20		1934
Montague (*v*)	60	80	May,	1934
Queen	50	50		1934
Salmon River	20	....		1934
Seal Harbour Gold	20	25		1934
United Goldfields (Brookfield)	25	25	Feb.,	1934
MANITOBA				
Beresford Lake (Oro Grande)	(*l*)	75	July,	1932
Central Manitoba	110	150	April,	1927
Diana Gold	30	100	July,	1934
God's Lake Gold	130	200	Sept.,	1935
Island Lake Gold (*g*)	(*l*)	50		1934
San Antonio Gold	300	300	July,	1932
Hudson Bay Min. & Sm. (Flin Flon)	4,300 (*p*)	4,600	Sept.,	1930
NORTHWEST TERRITORIES				
Eldorado Gold (pitchblende-silver)	....	75	Sept.,	1933
Bear Exploration & Radium (*t*)	.....	40	Oct.,	1935
BRITISH COLUMBIA				
Bralorne (*q*)	360	500	Feb.,	1932
Caribou Gold Quartz	110	200	Jan.,	1933
Colomario (*g*)	(*l*)	90		
Dawson Cons. Gold	(*l*)	25		
Dentonia	100	135	April,	1934
Dunwell	(*l*)	25	May,	1934
Grange (Pavilion Mt.)	(*l*)	50	Oct.,	0934
Highland Lass	(*l*)	....		1930
Island Mt. (Newmont)	90	100	Nov.,	1934
Jenny Long Gold	(*l*)	30		
Kelowna (Nickel Plate) (*s*)	230	250		1934
Kootenay Belle (*f*)	50	60	Dec.,	1934
Meridian	115	125		1935
Minto Gold	55	60	Dec.,	1934
Morning Star (Fairview)	30	50	Sept.,	1935
Nicola Mines (*d*)	60	100		
Pioneer	350	400		1928
Premier (*m*)	400	600		1919
Precambrian Gold	(*l*)	25		
Relief-Arlington (*h*)	40	100		1933
Reno	60	110	Aug.,	1929
Sheep Creek Gold (Queen) (*n*)	125	150	May,	1935
Superior (Providence)	(*l*)	50	Oct.,	1934
Surf Point (N. A. Timmins)	18	25		1934
Twin Lakes Gold	(*l*)	40		
Two Star	(*l*)	50		1935
Union (J. F. McCarthy)	(*l*)	200		
Vidette (*k*) (*a*)	(*l*)	75	Dec.,	1933
Velvet Gold	(*l*)	50		
Wayside Cons. Gold	25	100	Nov.,	1934
Windpass	40	50	Jan.,	1934
Wilcox	(*l*)	20		
Ymir Cons. (Goodenough)	(*l*)	150	July,	1935
Ymir Yankee Girl	100	125	Jan.,	1935
Cons. Min. & Sm. (Kimberley) (*u*)	....	6,600		
Cons. Min. & Sm. (Tadanac) (*a*)	....	2,400		
Brittania Min. & Sm. (*a*) (*u*) (*w*)	....	5,000		
Grandby Cons. (Anyox) (*a*) (*z*)	....	3,000		
Noble Five Mines (Slocan) (*u*) (*y*)	....	100		

(*a*) Copper-gold producer. (*b*) Produced $24,348 up to 1914. (*c*) Also treating ore from Moffat-Hall. (*d*) Intermittent operation in 1929, 1930, and 1934. Resumed in Aug., 1935. (*e*) Controlled by Mining Corp. of Canada. (*f*) Production of $83,986 prior to 1909; again active, 1927-28. (*g*) Production temporarily suspended. (*h*) Premier holds 52% interest. (*j*) Controlled by Ventures. (*k*) Milling resumed in Nov. after temporary shutdown. (*l*) Not reported. (*m*) Canada's second largest silver producer. (*n*) Formerly produced $1,300,000, 1909-'16. (*o*) Shipping approximately 100 tons monthly silver-lead-gold ore. (*p*) Copper-zinc-gold producer. (*q*) Also treating ore from Bradian mine. (*r*) Controlled by Cons. Min. & Sm. (*s*) Formerly largest B.C. gold producer. (*t*) Silver producer. (*u*) Gold-silver-lead-zinc producer. (*v*) Controlled by Minefinders Ltd. (*w*) Controlled by Howe Sound Co. (*x*) Smelter has treated about 400 tons of ore. Regular production started in Dec., 1935 (*y*) Former production $100,000; reopened Aug., 1935. (*z*) In Oct., 1935, plant and property sold to Cons. Min. & Smelt. (#) Milling stopped April, 1935.

Table III—Dividend Record of Canadian Mines, 1930-1935

Mining Company	1930	1931	1932	1933	1934	1935
Anglo-Huronian	.....	.....	.....	.....	0.40	0.20
Beaverdell Wellington Synd.	.....	.....	.....	.....	.....	0.70
Bralorne	.....	.....	.....	.....	0.62½	0.30
Buffalo-Ankerite	.....	.....	.....	0.08	0.16	0.20
Coniagas	.....	.....	.....	0.12½	0.12½	0.12½
Cons. Min. & Smelt.	12.50	1.25 (10% stock)	10%	1.50	3.00	6.50
Dome Mines (*d*) (*e*)	1.00	1.00	1.30	1.80	3.50	4.00
Falconbridge	.....	.....	.....	0.25	0.27½	0.30
Highland Lass	.....	.....	.....	0.06	0.15	0.17
Hollinger	0.70	0.70	0.75	0.85	1.40	0.90
Howe Sound (*a*) (*e*)	4.50	2.25	0.55	1.20	3.00	2.55
Howey Gold Mines	.....	.....	.....	.....	0.10	0.05
Hudson Bay Mining & Smelt.	.....	.....	.....	.....	.....	1.00
International Mining Corp. (*e*)	.....	.....	0.07½	0.15	0.15	0.50
International Nickel (*c*) (*e*)	1.00	0.45	.....	.....	0.50	0.75
Kerr Lake Mines (*b*)	.....	.....	.....	.....	0.03	.....
Kirkland Lake Gold	.....	.....	.....	.....	0.03	0.03
Lake Shore	1.50	2.40	3.00	3.00	3.50	4.00
Macassa	.....	.....	.....	.....	0.05	0.15
McIntyre Porcupine (*d*) (*c*)	1.00	1.00	1.25	2.00	2.00	2.00
McKinley Mines Sec. Co. (*f*)	.....	.....	.....	.....	0.02½	0.05
McWatters Gold	.....	.....	.....	.....	.....	0.05
Nipissing Mines	0.30	0.07½	.....	.....	0.12½	0.12½
Noranda Mines	1.00	.50	1.10	1.50	2.00	2.00
Northern Canada Mining	.....	.....	.....	.....	0.02	0.02
Pioneer of B. C.	.....	0.09	0.12	0.42	0.65	0.80
Premier Gold	0.24	0.12	0.12	0.12	0.12	0.13
Reno Gold	.....	.....	.....	.....	.....	0.14
San Antonio	.....	.....	.....	.....	0.05	0.21
Siscoe Gold	.....	.....	0.11	0.14	0.19	0.21
Sylvanite Gold (*e*)	0.02	0.04	0.05	0.07½	0.25	0.20
Teck-Hughes	0.60	0.60	0.65	0.60	0.55	0.40
Toburn	.....	.....	.....	.....	0.08	0.08
Wright-Hargreaves	0.05	0.15	0.20	0.27½	0.55	0.60

(*a*) Controlling mines in B. C. and Mexico. (*b*) Controlling mines in Canada, U. S., New Zealand, Australia. (*c*) On preferred stock a 7% cumulative dividend has been maintained since reorganization in 1929. (*d*) Plus tax on U. S. funds. (*e*) Paid in U. S. funds. (*f*) Holding company.

seven Ontario gold mines increased 300 per cent. On a tonnage basis, the advance was from 43½c. to $1.34; taxes per ounce of gold recovered moved up from 88¾c. to $3.56. According to Bateman: "In at least one northern Ontario mine taxes in 1934 were over $2.25 per ton, and for every dollar paid for wages 83c. was paid in direct taxes." Teck-Hughes pays taxes at the rate of one cent for every four cents distributed to shareholders, and in British Columbia the ratio is said to be one to three.

The percentage of increase in the value of Canada's gold output since 1931 is far behind the rising scale of taxation, as it is behind the increased production rate of the United States and Russia, with the result that both of these countries exceed Canada's 1935 record. Canada's gold output last year amounted to 3,290,664 fine ounces.

A 22 per cent drop in the average grade of ore mined in the Dominion, between 1932 and 1934 has been attributed to some extent to efforts on the part of operators to improve net profits under prevailing tax regulations. Viewing the active Federal cooperation with gold-mining enterprises in such countries as Australia, New Zealand, and Japan, as well as in the United States and Russia, the Canadian mining industry has for some time been in open protest against conditions.

Among the 41 mining companies which have announced official plans for entering the production stage within the next few months (see Table I), only 12 plan to install mills having a daily capacity of 100 tons or more. If these plans meet with success, new mines will contribute approximately 2,000 tons of ore per day to the existing rated capacity of approximately 34,150 tons (representing only the straight gold producers and Noranda). At the close of 1935 there were 115 gold mines in production; the mills to be brought into operation in 1936 should treat an additional tonnage estimated at 5.8 per cent. The quantity of gold produced in 1935 marked an increase of 10.8 per cent over the record for the preceding year, and a somewhat similar advance is again indicated for the current year. In 1934, all but 11 per cent of the Canadian gold output came from properties found more than 20 years ago.

Expansion of the gold-mining industry in the Dominion has continued on a scale similar to that of the two years preceding 1935. In 1934 the number of producers increased to 108; in 1935 the number was 126, with 14 other mines, not including intermittent producers and placer operations. (See Table II.) According to the Dominion Bureau of Statistics, 416 auriferous quartz mines were undergoing development in 1934, with payrolls amounting to $27,156,887 for 17,762 employees. The major groups of the mining industry in Canada purchased stores, equipment, freight, and insurance valued at $76,083,000 in 1934, of which gold mining alone accounts for 39.4 per cent.

It is interesting to note that the Canadian gold-mining industry includes six operators which rank among the 27 leading gold producers of the world. Lake Shore, in seventh place, follows Homestake, with a production of 471,762 oz. of gold recovered from 836,602 tons of ore milled, a higher grade than shown by any other mine in this group. Hollinger is in ninth place, Noranda is nineteenth; McIntyre, twenty-first; Wright-Hargreaves, twenty-fifth; and Dome, twenty-sixth.

In operating efficiency, these and other mines in the Dominion have established a highly creditable record. Developments in metallurgy have been outstanding. In maintaining an excellent rate of gold recovery, Canadian metallurgists have been ably assisted by the Federal ore-dressing laboratories at Ottawa, among the finest in existence. In the matter of maps and field reports of the Geological Survey and Mines Branch of the Dominion Department of Mines, there is also provided a service which ranks with the best to be found anywhere. Technical equipment and practical experience with a large diversity of ore deposits, and with a variety of transportation problems, offer assurance of aggressive expansion.

The Canada Geological Survey received an appropriation of $1,000,000 for field work in 1935, making possible unprecedented activity in mapping new districts. Data compiled by 188 field parties working in various parts of the Dominion are now being prepared for publication, with preliminary results indicating that 2,900 square miles in the Northwest Territories can be classified as favorable for gold prospecting, and 200 square miles in Manitoba. Promising areas have been indicated in British Columbia, Ontario, and Quebec, and much valuable information has been made available in classifying districts which were previously unknown.

The gain in the total dividend disbursement of mining companies in 1935 was due chiefly to enhanced earnings of the base-metal producers. With continued improvement in metal prices, the outlook for 1936 is the most encouraging since 1929. Base Metal Corporation and Big Missouri have talked of going into production; Sherritt-Gordon, Normetal, and other developed properties would be in line for similar action as soon as profitable markets are assured. Hudson Bay Mining & Smelting paid two 50c. dividends, suggesting a $2 rate for 1936; International Nickel and Falconbridge exceeded their 1934 rate.

To the list of dividend-paying gold mines were added Reno and McWatters, with initial dividends declared for payment in January, 1936, by Little Long Lac and Caribou Gold Quartz. Twelve gold producers paid larger dividends in 1935 than in the year previous, including Dome and Lake Shore; but it is significant that Bralorne, Teck-Hughes, Hollinger, and four other severely taxed gold producers were forced to retrench. Total Hollinger dividends and bonuses to date amount to about $80,000,000, from gold production valued at about $200,000,000, and in 1934 the Hollinger payment was larger than Homestake's, and was exceeded by only four of the great Transvaal producers.

Dividend-paying auriferous quartz mines numbered 13 in 1933, when $20,030,200 was paid; in 1934, 22 mines paid $27,888,731; in 1935 there were 25 gold mines, including Noranda, which dispersed $33,824,911.06 to shareholders. The total 1935 dividends disbursed by 32 mining companies in Canada amounted to $58,754,611.

(Continued from page 74)

United States Mining Revives

greatest gold producer continued to be Nevada Consolidated Copper at Ely.

Mines in Nevada produced 4,280,000 oz. of silver, compared to 3,057,114 oz. in 1934, an increase of 40 per cent over 1934.

Production of copper in Nevada increased about 68 per cent during 1935. The Nevada Consolidated Copper Company, at Ely, was the largest producer. Development at the Mountain City Copper mine revealed an orebody of high copper content.

Chief source of lead and zinc were the Combined Metals Reduction Company, with mines in Pioche, and the Treadwell Yukon Company, Ltd., in the Tybo district.

Plans to supply the Pioche silver-lead-zinc district with electrical energy from the Boulder Dam were started during the year. This new development will afford future expansion of this mining region.

UTAH • Gold production in Utah was 184,950 oz. in 1935, compared to 136,581 oz. in 1934. The largest producers were the Utah Copper Company, United States and Lark, and Park City Utah Mines Company.

Utah produced 9,133,900 oz. of silver during 1935, against 7,111,417 oz. in 1934, thereby maintaining second place as a silver producer. The major portion was produced by the United States Smelting, Refining & Mining Company from the United States and Lark groups, the Park City Consolidated, Eureka Standard, and Utah Copper. The Frisco Silver-Lead Mining Company struck a high-grade silver orebody during the year.

With increased operations in the copper industry, the tonnage of metal produced in 1935 amounted to 64,212 tons. The bulk of this copper came from the open pits of Utah Copper Company, which stepped up production in October to 20,000 tons of ore per day.

Production of lead in 1935 was 64,088 tons of metal, against 58,076 tons in 1934. Though silver production rose sharply, some increase of lead production naturally came from the siliceous ores, but the Bureau of Mines reports more than 75 per cent of the lead came from lead-zinc ore treated by flotation and most of the remainder came from lead ore of smelting grade. Utah Consolidated opened its Judge unit, starting daily production at 150 tons.

The main source of zinc in Utah was from the United States and Lark-Silver King Coalition, Hidden Treasure, and West Calumet mines. Most of the zinc was recovered in concentrating mills.

Employment in Utah mines increased during 1935, with about 6,000 men employed, against 3,500 in 1932 and 7,000 in 1929. About 30 lode mines reopened and started operations in 1935.

* AUSTRALIA *

Gold Output Highest in Years

Passes 900,000-oz. mark, with the Westralian fields counting for three-quarters . . . Base-metal producers better off

Peter G. Tait
Melbourne, Australia

FIFTEEN YEARS have elapsed since the gold yield of the Commonwealth of Australia exceeded 900,000 fine ounces, which figure will be surpassed again in 1935. In 1929 the record low yield of 427,159 oz. was recorded, and as the 1934 figure was 886,609 oz., an increase of over 100 per cent has been achieved in the short period of five years. The record high output was reached in 1903, when 3,836,000 oz. was produced. The State of Western Australia has been the chief producer since the discovery of the Golden Mile, Kalgoorlie, and is responsible for approximately 75 per cent of the yearly Australian output. Not only has the output more than doubled in five years, but the value in terms of Australian currency has doubled also, the average price of gold during the past year ranging around £8 15s. 0d. (say, $43) per ounce. The activity in gold mining, therefore, has been of material benefit to the community as a producer of an easily marketed commodity, and as a creator of employment, apart from the indirect stimulus it has given to other industries, notably engineering.

The Golden Mile, Kalgoorlie, has taken on a new lease of life. New plants are in operation at the Lake View & Star group, and the Great Boulder, and the new mill of the Kalgoorlie Ore Treatment Company is treating ore from the Boulder Perseverance and the North Kalgurli under a joint agreement. Great Boulder has been a consistent producer and dividend payer since its initial production in 1894. The new mill is treating over 10,000 tons monthly. Great Boulder ore reserves total 356,000 tons, averaging 7.63 dwt. per ton.

After the mines at Kalgoorlie the next field of importance is Wiluna, where Wiluna Gold Mines is treating over 500,000 tons per annum at a cost of about 19s. per ton. The ore reserves total 1,786,000 tons valued at 7.2 dwt. A new process has been developed by the company for the treatment of ore from the Moonlight leases. The flotation concentrates from the mill will be roasted to eliminate the arsenic and some of the sulphur, then calcined and smelted with lead ore in a blast furnace. The company holding the leases is arranging with the Wiluna company to erect a plant to treat 10,000 tons monthly. Many new mines have been established and are in operation. These include the Lancefield, at Beria, which is equipped to treat 120,000 tons per annum and has proved reserves of about 500,000 tons; the Norseman, with a treatment capacity of 60,000 tons per annum and reserves averaging 9½ dwt.; the Triton, at Reedy, and the Mount Magnet. Among those which expect to start milling early in the new year are the Ora Banda Amalgamated and the Celebration, each of which will treat about 50,000 tons of ore per annum.

Two Queensland mines worthy of special mention are the Mount Morgan and Golden Plateau. Mount Morgan now holds promise of rising again to become one of the premier mines of Australia. The mill capacity has been increased to 250,000 tons per annum. The company's ore reserves are estimated at 7,652,000 tons assaying 4.26 dwt. gold and 1.77 per cent copper. Costs are 7s. 5d for mining and 8s. 10½d. for concentration. The Golden Plateau company, on the Cracow field, which was formed in 1932, has been very successful. The plant is now being increased to treat 50,000 tons per annum. In the year ended June last, 35,464 tons was treated for a yield of 31,375 fine ounces, the recovery being 96.74 per cent. Mining and treatment costs, including development, averaged 18s. 6.12d. a ton. Ore reserves are conservatively estimated at 232,000 tons, containing 92,900 fine ounces of gold. Dividends for the year totaled £182,000.

In Victoria no large-scale productive operations are in progress, the gold output coming principally from small reef and alluvial claims. An important development program is being carried out at Bendigo, where Bendigo Mines, Ltd., is sinking three large shafts on the Napoleon, Carshalton, and Nell Gwynne leases in the hope that new reefs will be discovered. If successful the operations will mean new life for the field, which has to its credit a larger output of gold than any other district in Australia.

Talbot Alluvials, Ltd., a London company in which Mount Elliott, Ltd., Oroville Dredging, Ltd., and Camp Bird, Ltd., are interested, is engaged on the development of the Victorian deep leads in the Avoca district. Preliminary

work is approaching completion and treatment operations will soon commence. The program provides for the extraction of 70,000 fathoms of wash a year. Recently, 432 fathoms returned 369 oz. of gold, but this is below the official estimate of average values. Two subsidiaries, Madam Hopkins Gold Mining Company and Homebush Gold Mining Company, are also being developed.

Several of the old mines of New South Wales have been reopened, notably the Occidental and the New Cobar, at Cobar. The ore reserves of the former are estimated at about 310,000 tons assaying 8 dwt. Production at the rate of 5,000 tons monthly has started. The New Cobar is still in course of development, though ore reserves proved by previous holders are estimated at 240,000 tons assaying 6.5 dwt. and 1.9 per cent copper.

The output of the New Guinea gold fields, which is not included in the Australian figures, is steadily increasing. During the year ended June 30 last, 299,750 oz. of gold, valued at £1,897,244, was exported. The bulk of this gold was from the Morobe gold field, the principal contributors being Bulolo Dredging Company and New Guinea Goldfields. The former company has four large dredges at work, and is treating approximately 1,000,000 cu.yd. monthly. In six months of 1935, 5,419,000 cu.yd. were treated for 62,368 fine ounces, valued at £547,169. The working profit for the period was £379,926. The transport to this field is wholly by airplanes, no fewer than 40 machines being engaged in the service. Freight for the year amounted to 1,744,746 lb.

In the Papuan portion of the island of New Guinea there is also increased activity, particularly in the Misima section. Cuthbert's Misima, which has been operating very profitably for several years as the New Misima, has been floated with a capital of £200,000. The plant is being reorganized and extended to treat 40,000 tons per annum. Other companies are the Misima United, Misima Central and Misima Gold Reefs, Quartz Mountain, and Gold Mines of Papua.

The Broken Hill mines in operation are the North, South, Zinc Corporation, and Sulphide Corporation, their combined output being in the neighborhood of 1,300,000 tons of ore per annum. The South mine has completed a new lead and zinc flotation mill with a capacity of 8,000 tons weekly. This is housed in a steel building with reinforced-concrete floors. The Electrolytic Zinc Company, at Risdon, Tasmania, which obtains its supplies of zinc concentrates from Broken Hill, owns the Read-Rosebery group of mines, in Tasmania. A modern mining and treatment plant with a capacity of 3,500 tons weekly was completed in 1930, but world economic conditions caused a halt. The better prices ruling recently have been of material benefit to the industry, and there is every possibility that the Electrolytic Zinc Company will bring the Read-Rosebery mines into production at no distant date. In addition, the Broken Hill Proprietary Company has recently resumed operations.

Mount Isa Mines, Queensland, the only other important silver-lead producer, is treating over 500,000 tons of ore yearly, and has recently begun to produce zinc concentrates at the rate of 80,000 tons per annum.

Broken Hill Associated Smelters, at Port Pirie, South Australia, furnishes an outstanding example of a plant which is maintained at the best stage of efficiency. The yearly output is approximately 160 tons of lead, 4,600,000 oz. of silver, and 2,500,000 oz. of gold.

In the copper section, Mount Lyell Mining & Railway Company, on the west coast of Tasmania, continues to be the main producer of copper. During the year ended Sept. 30, 1935, the company produced 14,078 tons of blister copper. The net cost of production and realization (£43 per ton) was lower than at any time during the past 25 years. Despite the low average price for the metal during the year, the company was able to report a profit on mining operations, apart from profits earned on its investments. The ore reserves of the mines have been recalculated, and are now estimated to total 7,593,000 tons, of an average assay value of 2.05 per cent copper, 0.17 oz. silver, and 0.02 oz. gold. About half of the company's output of refined copper is shipped to the works of Metal Manufactures, Pty., Ltd., at Port Kembla.

* AFRICA *

Metal Production Increasing

Price of gold stimulates feverish search . . . Rhodesian copper producers prosper . . . Diamond mining looking up

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WITHIN the short period of 50 years Africa has advanced from nothing to foremost place in the provision of some of the world's metals and minerals, and is also producing rapidly or gradually increasing amounts of almost all of the metals and minerals of commerce. Prospecting, exploration, development, and equipment expenditures have so frequently brought big rewards that such activities are continuing to be extended. In some quarters it has almost come to be felt that anything cannot be valueless if it is in Africa, and this assumption, of course unwarranted, is causing scores of old finds and abandoned mines to be re-examined. It is already apparent that the cost of such re-examination work will not be wholly wasted.

Northern Africa—No mining discoveries of outstanding importance were reported from Northern or Northeastern Africa last year. An Abyssinian oil concession secured for interests in the United States threatened to lead to international complications and is reported to have been abandoned.

Kenya and Tanganyika—Further discoveries of gold were made in Kenya Colony and Tanganyika Territory in 1935. Prospecting continued active and several companies proceeded with the development, begun earlier, of numerous ore deposits. A mill of 100 tons' daily capacity was completed by Kimingini Gold Mining Company in the Kakamega district and began crushing in June. Results were slow in coming up to expectations, because retarded development work restricted the tonnage of primary ore from the lower levels needed to mix with the clayey ore mined nearer the surface. This difficulty seemed well on the way to being overcome when the year ended. Other companies, particularly Kentan Gold and Kenya Consolidated, conducted exploratory and development work in the Kakamega and adjacent areas, with encouraging results.

In Tanganyika Territory what appear to be important deposits of gold are being developed by Kentan Gold Areas in its Sanza Concession immediately south of Lake Victoria, and by the East African Goldfields in the Lupa gold field. Engineers employed by the Government and others prominent in the profession inspected these developments and expressed their opinion that Tanganyika Territory gives promise of becoming a large producer of gold.

Northern Rhodesia—Copper production continued to be the chief mining

activity in Northern Rhodesia in 1935. Roan Antelope Copper Mines and Rhokana Corporation both paid initial dividends last year. Despite low metal prices and the necessity of curtailing outputs, the operations of these companies have been profitable from the outset, and last year's advance in the price of copper practically doubled their net earnings.

Roan Antelope made progress with the sinking of the Storke shaft, a second working shaft which will make the deeper ore farther west available by the time it is needed, which will be three or four years hence. Stoping in panels up to 600 ft. high was successfully introduced. Underground developments continued to be carried far ahead. Milling practice was further improved, increasing the capacity of the plant and the percentage of values recovered. The second reverberatory furnace was completed and put in operation in 1935, and smelting costs were further reduced.

Rhokana Corporation proceeded with the development of its Mindola mine on the extension of its Nkana ore deposit. The vertical working shaft there reached a depth of 1,078 ft. at the end of June, and three other shafts were being sunk to expedite development. Extensive expenditures were made on the surface for the benefit of employees, and milling, smelting, and refining practice was further improved. On Rhokana's concession areas 1,635 additional square miles was traversed and mapped, and of the discoveries made a few are being investigated.

Mufulira Copper Mines completed the erection of its smelter and the large addition to its concentrator in 1935, bringing its capacity up to 6,000 tons of ore daily, at about the end of the year. Its operations reached a profitable stage early in the year, and it is still rapidly reducing production costs. Mufulira is now prepared to increase its production materially when market conditions justify.

Rhodesia Broken Hill Development Company produced approximately 20,000 tons of zinc in 1935, the rise in the price of the metal making the operation profitable during the last half of the year. It also resumed the production of vanadium concentrates and fused vanadium oxide.

A number of gold discoveries were made in 1935 by the companies holding prospecting concessions, but only one of these so far gives promise of becoming valuable. The drilling operations carried on by Luiri Gold Areas produced one sensation, but seem not to have outlined any considerable deposit of payable ore. Insufficient gold has been found seriously to shake the belief, established many years ago, that Northern Rhodesia is not a gold country.

Southern Rhodesia — Southern Rhodesia's gold-mining activities have been particularly stimulated by the higher price of gold, because so many of its almost innumerable known veins have been considered either too narrow or too low in grade to permit of profitable working when the metal was at its former price. The result is already becoming apparent, the value of the gold output having risen from £4,014,034 in 1933 and £4,695,747 in 1934 to £5,000,000 or more in 1935, thus increasing by 25 per cent in three years. Rich developments in the bottom levels of one of the deepest mines have strengthened confidence. As several previously abandoned properties are being re-equipped, production will undoubtedly increase considerably this year. The production of chrome, silver, pyrites, asbestos, and coal also showed a tendency to increase, and lithium is beginning to receive attention.

South Africa — Diamonds were so hard hit by the depression that their production in South Africa had to be largely suspended, but the demand has revived, and productive operations were being resumed when 1935 ended.

In the great Witwatersrand gold area activities increased amazingly in 1935, this applying alike to ore production, development, and exploration. According to a statement by Dr. J. G. Lawn, operations at the end of the year were 30 per cent greater than in 1932, all the extra tonnage being made up of ores unpayable prior to the recent advance in the price of gold.

Several mills were enlarged, new shafts sunk, and far more diamond drilling was done. Drillings east and west greatly extended the known length of the gold measures. If the law limiting capital expenditure is repealed and taxation so revised as to give encourment, still more rapid expanion of the mining industry may be expected.

Witwatersrand's output, which had declined from 11,553,564 oz. in 1932 to 10,486,333 oz. in 1934, rose to about 10,800,000 oz. last year, the increase being surprisingly small in view of the much greater tonnage of ore milled.

Southwest Africa—Further progress was made in 1935 in the recovery of diamonds from the additional alluvial deposits discovered in Southwest Africa, and extensions of such diamondiferous areas were proved. Hardly any work was done on the two copper mines in that region.

Belgian Congo—The outstanding development in the Belgian Congo in 1935 was a further large increase in the production of tin. From only 600 or 700 tons a few years ago the output has jumped to 6,000 tons of tin concentrates annually. Deposits in the Eastern Congo are believed to be extensive, and production will probably be greatly increased when quota restrictions are removed.

West Africa—The higher price for gold has so reawakened interest in the possibilities of the Gold Coast that activities there in 1935 became second only to those on the Witwatersrand. Old companies resumed development work and numerous new companies were financed, at least two mining finance groups which had long ago disposed of their interests there re-entering the field. Production of gold, which had been growing since 1931, was still further increased.

Production of diamonds by Consolidated African Selection Trust from its extensive alluvial deposits in Gold Coast Colony continued uninterruptedly in 1935, and profits were larger, approximately £163,000 being distributed in dividends.

Sierra Leone Selection Trust, a subsidiary of Consolidated African Selection Trust, has carried forward the work of proving diamond deposits in Sierra Leone. It was so successful that it paid its initial dividend last year. Gold deposits were also worked productively in Sierra Leone last year, and the whole country is being intensively prospected.

The feverish search for gold which is now causing every hitherto neglected portion of Africa to be penetrated may be expected to bring to light other of that continent's mineral resources.

Washing alluvial diamond gravel, Southwest Africa

* RUSSIA *

Mineral Industry Set for Faster Growth

Construction of railroads to distant mining regions removes obstacle to development of natural resources

H. C. Chellson

Assistant Editor

WITHIN THE BORDERS of Soviet Russia's expansive area are metalliferous provinces the steady development of which is formulating an answer regarding her mineral wealth. Seventeen years ago, only 10 per cent of the total area had been covered by geological exploration. Now that about 45 per cent of the country has been geologically studied, the possibilities of the nation's potential mineral wealth can be better estimated. At the close of 1935 about 850 geological and exploration parties turned in their reports covering investigations on prospective mineral areas. Results of extensive drilling programs on precious- and base-metal mines are more complete; therefore, limits of new orebodies have been determined and new mines opened. The principal mining regions in the Ural, Caucasus, Altai, and Central Asia, and those in the Far East, are annually producing greater tonnages of metals, and with greater development ore reserves increase. Railroads have been built to some of the remote mining regions, and with greater funds available for mining machinery, the industry is concentrating efforts in strategic directions leading to faster development of important mines. Though this new phase is considered a great achievement, the mining industry is admittedly behind other industries in the country's program of industrialization.

During the first five-year plan the mining trust was one unit, but a complete reorganization in May, 1933, made the gold-mining division, Glavzoloto, headed by A. P. Serebrovski, independent of the base-metal section, now led by A. S. Shakhmourodov. Following this change in administrative authority, decentralization and initiative were encouraged among field engineers and directors in the attempt to reduce bureaucracy and red tape. Plans were made for greater gold production and development of all mines.

Geological expeditions had discovered new placer deposits, and itinerant labor was encouraged to flock to these gold fields by the announcement that higher wages would be paid and ample food and housing conditions provided.

In the second half of 1933 gold production mounted, due in no small part to the thousands of placer miners scattered throughout Siberian gold fields. In May, 1934, stronger measures were taken to crystallize this prospecting army and make it larger. Laws were passed whereby prospectors might be considered somewhat of a privileged class. Units of the gold trust were set up which would grubstake groups of prospectors. These groups or artels contracted to deliver gold to the trust and in turn receive foodstuffs or other commodities. Farmers could become part-time prospectors and thereby avoid paying an agricultural and transport tax so long as they remained gold diggers. As a result, numerous rich placer areas in Central Asia, Siberia, and the Far East were further developed during 1935 by a great army, consisting of about 100,000 grubstake prospectors and about 400,000 persons who were directly employed in the numerous dredging and hydraulicking operations and among hundreds of placer and lode mines.

Though placers account for the major part of gold now produced, the lode mines are being developed and equipped with machinery, and, therefore, are constantly increasing their percentage of total production. To achieve a greater increase of gold during 1936, more labor will no doubt be needed, and possibly additional concessions will be promoted to encourage more people to mine gold.

Though placer mining is considered the most important phase of the gold-mining industry today, the future large-scale activities will be in the eastern mountain ranges of Central Asia along the Mongolian border. These ranges consist of the Pamirs, Salyugen, and the Saian Mountains. The Yablonovi Mountains east of Lake Baikal also contain important mineral deposits. Developments of some mines in these regions indicate very high-grade ore, and once they are mechanically equipped and metallurgical plants erected, gold production should mount to high levels.

In the Far East not far from the Manchurian border are the Balay gold mines. The veins are gold quartz with calcite in granite, and are narrow but exceedingly rich. In 1934, between 4 and 5 metric tons of gold were produced, and this amount was nearly doubled in 1935, and during 1936 the objective is to double the 1935 output. The Darasun mines, lying north of Balay, in the Yablonovi Mountains, are producers of gold, silver, copper, lead, and arsenic. These veins are gold quartz in a granite batholith through which have intruded dikes of diorite, aplite, granodiorite, and pegmatites. Electrical energy is supplied by a large power plant and ore is concentrated in a modern flotation plant. A railroad recently completed serves this area, which is rich in timber and metals.

It is impossible to estimate the potential wealth of developed and undeveloped gold regions in the Soviet Union. As far back as 1901 a well-known American engineer, C. W. Purington[1], who examined gold mines throughout Siberia, wrote: "G. F. Becker, American statistician and mining engineer of the most eminent authority, places future production of the Witwatersrand gold mines of South Africa at $100,000,000 a year for the next thirty years—dependent, of course, upon restoration of peaceful political conditions. I regard it not an unsafe prediction to estimate the Siberian annual output at $200,000,000 for a period of at least thirty years, providing American machinery and gold-mining methods are installed throughout the territory now occupied by the Russian and Siberian operators." The Soviet now desires to quadruple its 1933 gold production by 1939. This would be about 11,000,000 oz. ($385,000,000), a sum exceeding the Rand production of 1935.

Soviet gold production in 1934 was estimated at 4,262,672 oz. Production in 1935, estimated at 5,984,098 oz., indicates the rate of increase to be little more than 40 per cent above that of 1934, considering the 1935 program was completed ahead of schedule. Maintaining the same rate up through 1939, it is likely that Russia will reach approximately 11,000,000 oz., thereby exceeding the Rand, provided, of course, the Rand continues to mine low-grade ore. By 1939, however, two or three new mines in the Rand are expected to be in operation, thereby adding to the Rand gold production, which was estimated to be 10,750,000 oz. in 1935. Therefore, Russia's effort to surpass the Rand by 1939 will involve heavy purchases of mining equipment, intensive mine development, and greater employment in gold mining.

The gold ore shipped to the Tacoma smelter, in Washington, comes principally from high-grade prospects in the remote regions of the Ural Mountains, Central Asia, and Eastern Siberia. The ore is sent to the nearest point on the Trans-Siberian Railroad and freighted to Leningrad, then shipped via the Panama Canal to Tacoma. This is a more rapid method of shipping gold earmarked for purchases in the United States. During 1935 about 214,900 oz. of Russian gold was estimated recovered in Tacoma. Concentrates, slimes, and accumulated tailings from hundreds of small Chilian mills were shipped to

[1] *Engineering Magazine*, Vol. 21, 1901, p. 903

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SCENES FROM SOVIET MINING REGIONS

1 Kounrad copper mines, in Kazakstan, situated near Lake Balkash. Operations have started in this porphyry deposit, estimated to contain 2,600,000 tons of copper

2 Drilling in remote Kazakstan. Water is hauled in barrels by oxen to the rig

3 Djezkazgan copper mines, in the steppe country of Central Asia. This No. 1 shaft hoists ore from the flat-lying Pokrovsky orebody averaging 3 per cent copper. The ore is dumped into railway cars and hauled 36 miles west to Korsakpi

4 Supplies arriving at Djusaly, on the Tashkent-Orenburg railway, are hauled north 225 miles to Korsakpi by camels

5 American and Russian trucks transport passengers and urgent freight over caravan roads to mines and prospects

6 Korsakpi, where Djezkazgan copper ore is concentrated and smelted. Coal is supplied from the Bai-Kanur mines near by

7 A Buriat camel driver brings a cargo of sugar to the Darasun gold mines, in Far Eastern Siberia. A narrow-gage railway now affords more rapid development of this region

8 Men and women placer for gold on the western slopes of the Altai Mountains in Eastern Kazakstan

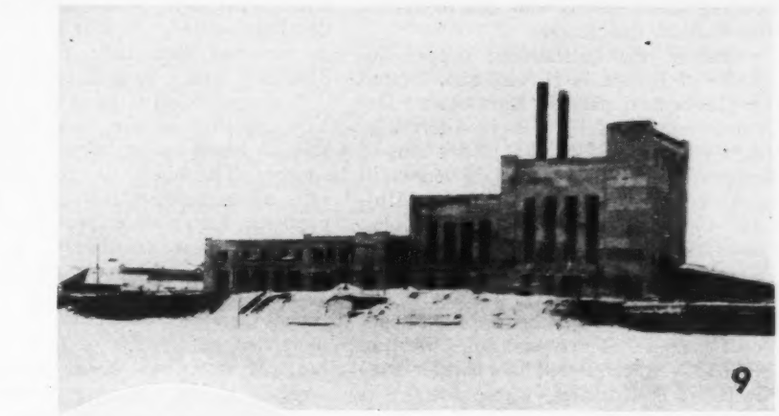
9 Power house at the Gluboki lead-zinc mines in the Ridder district

10 Going to town. The burro and camel driver observe no speed laws on caravan trails leading from Achesai mines

11 Portable Kazak "yurts" serve the Russian engineer as home and office when working in the steppe country

12 A housing project nears completion at the Kounrad copper mines. A railway completed this year connects this copper region with the Trans-Siberian railroad

Photos 3, 4, 6, 9 Courtesy P. Steffensen. 1 and 12 Sovfoto



the Eastern seaboard of United States, and about 400,000 oz. of gold were recovered in 1935. The estimated total of 614,900 oz. recovered during 1935 in the United States from Russia represents ore mined possibly one or two years ago, and the tailings may be much older. Therefore this figure is not added to the estimated gold production of 1935. Since Russia desires to make more purchases in the United States, it is possible that more ore and concentrates will be shipped in 1936.

The silver supply of Russia is apparently ample for domestic requirements, as many of the gold and base-metal mines contain silver, and production increases with that of other metals.

In the field of copper, lead, and zinc, Russia has devoted the last three years in establishing a better basis for producing these metals and has overcome mechanical deficiencies.

One of the outstanding copper deposits of Russia is Djezkazgan, located in the central part of Kazakstan. Development and drilling have determined the existence of 3,250,000 metric tons of copper, found in a series of lenses in gray copper-bearing sandstone of Middle Carboniferous formation. These deposits appear to be in the trough of a regional syncline, or geosyncline, in which minor folding is present. The average content of the ore is 3½ per cent copper. Thirty-six miles west of Djezkazgan, connected by a narrow-gage railway, is Korsatpi, where the ore is shipped to be concentrated by flotation and then smelted. A broad-gage railroad to these mines, expected to be completed soon, will facilitate transport of heavy machinery and equipment for greater expansion.

Near Lake Balkash is the porphyry copper deposit of Kounrad. Development and prospecting in this remote region since 1928 have developed orebodies estimated to contain 2,600,000 tons of copper. This enterprise has had many difficulties, involving a tremendous expense, but with the completion of the railroad in January of this year Kounrad approaches closer to the production stage. The operations will be by open-pit mining, and steam shovels are now digging initial cuts.

Along the Angren River near Tashkent are the Almalyk copper deposits, which have been prospected and partly developed during the last five years. It is reported that they contain about 3,000,000 metric tons of copper.

A copper deposit found in the Middle Volga region, known as the Bliava, is said to have ore averaging 4 per cent copper. The deposit is reported to contain about 3,000,000 tons of metallic copper. Large-scale production from this deposit is not likely until after 1938, though preliminary open-pit operations have started. A deposit of ore thought to be similar to the copper-molybdenum deposits at Greene Cananea, Mexico, has been developed at Agarak, in the Caucasus, where development so far discloses about 800,000 tons of copper and 25,000 tons of molybdenum.

Copper mines now producing the bulk of production are in the Ural and Caucasus Mountains, and the steppes of Kazakstan and Siberia. The present program of producing 200,000 tons of metallic copper by the end of the second five year plan, 1937, is less than the total 1935 production from Arizona and Montana, amounting to 213,000 tons. With railroads now connecting some of the largest Soviet copper deposits, and production steadily gaining, due to better mechanization and more experienced miners, it is likely the copper programs will be fulfilled. Russia's total copper reserves are now estimated to be about 17,500,000 tons of metal. Demand for copper is great and there is no doubt that imports in 1936 will exceed those estimated. Imports amounted to about 30,000 tons in 1935, against 11,487 tons in 1934.[2]

The lead industry of Russia appears to be more deficient than the copper or the zinc industry. In four years from 1930 to 1934 lead production increased from 11,000 tons to only 27,000 tons. The new 20,000-ton unit of the Chimkent smelter started operations in January, 1934, and doubled production in 1935. Most of the ore now comes from the Achesai and Kara-Kan-Sai mines,

[2]Statistical Survey of Foreign Trade, U.S.S.R.

(Continued on page 101)

MINING SPOTS in the Soviet Union where production of precious and base metals adds to the country's wealth

* MINING PRACTICE *

Toward Greater Efficiency

Increasing depth of operations brings new problems in hoisting, ground support, and ventilation

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RECENT YEARS have witnessed increased prosperity in gold mines and a struggle for existence in all others. Paradoxically, both these influences have tended to bring about an increased effort for lower costs. In respect to gold, the incentive has been to bring under development still lower-grade properties or to permit existing mines to extract ore too low in grade for the old price and somewhat low even for the new price. In the deep-mining gold areas the increased price of gold has also been an added incentive to reach out for greater depths than had previously been thought commercial. On the Witwatersrand, the Robinson Deep has now reached a depth of 8,500 ft. in development and is actually mining at 7,500 ft. The miners of the Rand are now talking confidently of attaining depths of 10,000 ft., which will bring in an enormous tonnage of gold ore previously considered beyond workable depth.

A decided trend has developed toward greater mechanization, in both stope and development work. The use of slusher scrapers in larger numbers and greater sizes is almost universal. Scraper hoists are now made up to 150 hp., the larger sizes being electrically driven. Power shovels are also increasingly used, and a new type, the Eimco-Finlay, is finding successful application in drifts as small as 5x7 ft. Endless conveyors, which found their first extensive underground use in coal mines, are now being adapted more widely to metal mines, largely for conveying material from crushers to ore pockets. The possibility presents itself of using them for transferring ore from one shaft to another in two-stage hoisting, although no instance of this use has come to my attention.

Mining operations tend to become more definitely standardized. Stoping operations are now quite commonly carried out according to a standard schedule, and in no application is this more marked than in the recovery of "remnants" on the deep levels of the Rand. In the dangerous work of recovering these parts of the lode, where rock pressure is heavy and the danger of pillar-bursts great, the common practice is now to schedule in great detail the method of attack, the maximum number of men to be employed on a "remnant," and the scheme of operations.

Mechanical hole directors, made of pipe and steel, are being extensively used on the Rand to secure proper placing of holes and a definite burden on the powder. Where conditions permit, greater level intervals are being used to decrease the amount of development per ton of ore. At the Flin Flon mine, the level interval is usually 260 ft., and in some properties as great as 520 ft.[1] Increased use of grizzly chambers is another marked tendency. This permits larger-scale blasting and more effective use of powder with less risk to chutes than when chute blasting is used. At the Howey mine grizzly chambers are being successfully applied to shrinkage stopes.[2]

In stoping, the tendencies are somewhat confusing; shrinkage stoping is being abandoned in many mines for methods which give cleaner mining. There is also an increased use of resuing for the same reason. On the other hand, a modified form of shrinkage, either with or without timber support of the hanging wall, is finding favor on the Rand because of the ease of ventilation and the temporary support which the broken ore gives to the hanging wall. There is also an increase in the use of shrinkage with caving of the pillars before drawing off the residual ore. Both Britannia[3] and Granby[4] have resorted to large-scale blasting, using powder pockets from drifts or raises and long drill holes for powder placement. There has been an increased use of sublevel open stopes and improvement in details. At Flin Flon[5] the box holes driven to the stope deliver into transfer drifts, through which the ore is drawn by slusher scrapers to the grizzlies. This reduces the number of grizzlies required and makes it possible to do blockholing of boulders in the transfer drift without damage to the raises. At this mine pillars are left at 250-ft. intervals and the stope is started midway between the pillars by driving a raise through the center of the stope. At the intersection of each sublevel, slashing is carried out around the raise and the bench shot off until the full width of the stope is obtained. When this has been completed to the level above, stoping is carried on, retreating both ways from the central opening toward the pillar. In each pillar there is a service raise equipped with a cage for handling men and supplies to the stope. At Noranda[6] the inclined stopes are being replaced in the large "H" orebody by horizontal sublevel stopes. In their method provision is made for men to enter the stope and blockhole large boulders under the protection of the upper half of the first bench, as may be seen in the accompanying sketch. Jointed steel is used for drilling the bench, and bench and slash holes are drilled concurrently. All benches are shot simultaneously. The stopes will be filled with a mixture of slag and pyrrhotite tailing. Experiments have shown that the oxidation of the pyrrhotite cements this into a mass somewhat like weak concrete.

Attempts are being made to apply mechanical principles to the calculation of mine roofs and supports[7]. This is a noteworthy attempt to apply scientific principles to mining and, under some conditions, should be of considerable value. In deep mines, however, and where the overburden is extremely irregular in distribution and character, it is probable that the cost of test drilling would far exceed any saving that could be made. On the Rand, where wall pressures are high, any form of incompressible support, such as concrete disks and "pancakes," is being abandoned, and "pack mats" and "chock mats" are increasing in favor[8]. The "pack mats" are 2 to 2½ ft. square and are made up of layers of three 3-in. round poles, each layer being placed in a direction at 90 deg. to the one below. The "chock mats" are of heavier construction, up to 4 ft. square, and with squared or flattened timbers 4 in. in thickness, placed side by side. Another form of compressible support is made up of short lengths of old steel rails stood on end in a sand-filled pipe. As pressure develops, the rail is forced down into the sand. Recovery of the props is made by washing out the sand with high-pressure water.

Deeper Hoisting in One Lift

One of the most important innovations in hoisting is the adoption of a greatly increased depth of single lift at the Rand. Simmer & Jack mine has recently installed equipment for hoisting 6,300 ft. in one lift, and other mines are going to slightly less depth. To permit doing this without unduly increasing the size of the rope, the government regulations have been revised to allow a safety factor as low as 4.7 for ore and 5 for man hoists on these long lifts. This was done after experimental proof that a lower factor of safety is permissible in the use of long ropes. Elaborate experiments are now being conducted to determine the strains in the ropes during different periods in the hoisting cycle, to ascertain safe rope sizes more definitely. Automatic controls to prevent sudden application of brakes or of power are required when the low factor of safety for ropes is used.

Use of aluminum-alloy skips and

cages is showing a world-wide increase. Steel, wood, and rubber are being used as liners where the wear is greatest. The saving in weight varies over a wide range, but an examination of figures submitted by the Aluminum Company of Canada indicates that the weight of aluminum-alloy skips may be as low as 65 per cent of that of a corresponding steel skip, and in cages the weight of the aluminum-alloy skip may be as low as 55 per cent of a steel skip. International Nickel has just announced the changing of the construction material of its Frood skips from carbon steel to nickel-alloy steel. This has permitted increase of the ore load from 19,000 to 22,000 lb., and the skip weight has been decreased from 15,000 to 12,000 lb. This means that the proportion of ore load to total load has been increased from 56 per cent to 65 per cent. Application of alloy steels of high strength and corrosion resistance to the construction of skips and cages offers distinct possibilities for hoisting larger quantities of ore or of hoisting from greater depths without increasing rope or hoist size. The relative merits of steel and aluminum alloys for this purpose have not yet been determined.

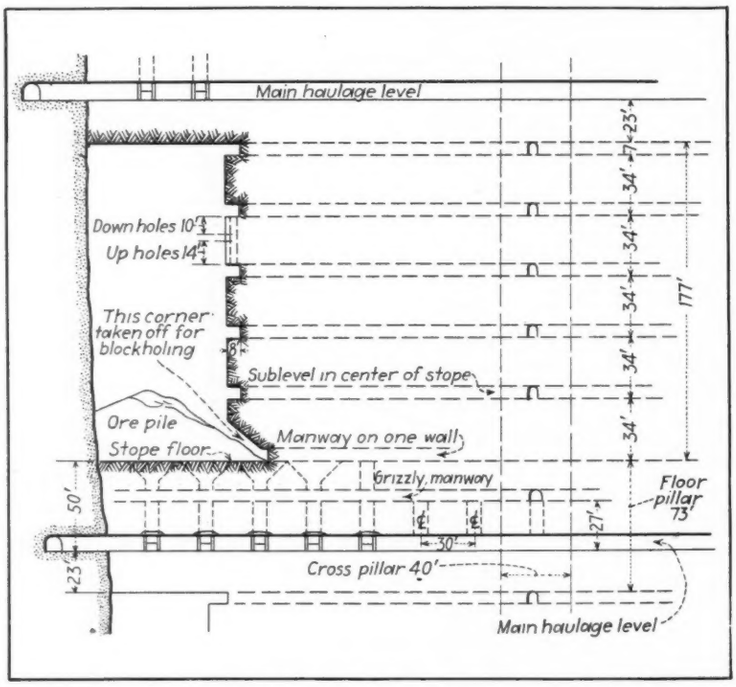
On the Rand, with its great depths and high tonnages, the seven-compartment rectangular shaft is becoming almost standard: four skip compartments, two cage compartments for handling men and supplies, and one compartment for ladder, pipe, and complementary equipment.

In drilling and blasting, two notable developments have occurred. "Hot-milling" of bits is rapidly gaining favor, as it gives a well-formed bit of accurate gage. The second item which gives promise of greater safety is the safety primer recently developed[9]. In this the cap is embedded in inert material such as wood.

In mine ventilation, the greatest developments have naturally come from the Rand, where ventilation has been for some time an acute problem. Screw-type fans are there replacing all others, more than twenty having been installed in the last three years. They are compact, give low heating effect, and have high efficiency under a great range of pressure and volume. At the Robinson Deep mine the Carrier Engineering Corporation has recently installed an air-conditioning plant on the surface capable of treating 400,000 cu.ft. per minute and cooling it to 33 deg. F. It is estimated that this will lower the underground temperature from 8 to 12 deg. F. At the East Rand Proprietary and the Crown Mines underground air-conditioning plants have been installed, in both properties at a depth of 6,500 ft. Both use non-toxic, non-irritant refrigerants. At the Daggafontein Mines, Ltd., dehumidified compressed air is being tried out experimentally: a turbro compressor of a capacity of 14,000 cu.tt. per minute compresses air to 80 lb., provision being made for its complete dehumidification. This air will be used for driving machinery in the mine, and the first trial will be made on a 400-hp. pump installation. The exhaust, which will have an estimated temperature oi minus 70 deg. F., will be carried in insulated pipes to working places for mixing with the atmosphere to cool and dry it. The problem of proper mixing and distribution remains to be worked out, but the experiment seems to be scientifically sound and very attractive.

For dust removal, local filters made of flannel bags have been installed with considerable success[10]. These are used to treat air where there is a more or less constant source of dust, such as at ore pockets. In England, laying of the injurious, fine dust by castor-oil atomizers is reported to have been quite successful. Experiments are being tried in various places on electrical precipitation of dust, small injector-type filters for removing dust at working faces, and thermal precipitation of dust for sampling mine air.

In prospecting and development, geophysical methods are being reduced to a sounder and saner basis and are proving valuable tools in the hands of the geologist and mining engineer. Some of the claims that are still made, however, may well be viewed with caution until experimentally demonstrated. One of the most notable recent applications has been the use of magnetic methods for tracing out the Rand bankets into



HORIZONTAL SUBLEVEL STOPES are replacing inclined stopes in the large "H" orebody at Noranda. Provision is made for the men to enter the stope and blockhole large boulders under protection of the upper half of the first bench

[1]"Mining Methods and Problems at Flin Flon." Bulletin, the Canadian Institute of Mining and Metallurgy, March, 1935.

[2]"Mining System at Howey." *Canadian Mining Journal*, Vol. 55, p. 447.

[3]"Mining Operations at the Property of the Britannia Mining & Smelting Company, Ltd., Britannia Beach, B. C." Information Circular 6815, U. S. Bureau of Mines.

[4]"Large-Scale Blasting." *Canadian Mining Journal*, Vol. 56, p. 175.

[5]*Op. cit.*

[6]Personal communication. Also, "Mining at Noranda." *Canadian Mining Journal*, Vol. 55, p. 155.

[7]"Use of Models for the Study of Mining Problems." T. P. 425, A.I.M.E. Also, "Application of Principles of Similitude to the Design of Mine Workings. T. P. 529, A.I.M.E. Also, "Mechanics and Mining." *E.& M.J.*, Vol. 136, p. 74. Also, "Mine Roof and Support Design." *E.& M.J.*, Vol. 136, p. 178.

[8]"Recent Developments in Mining Practice on the Witwatersrand." Bulletin No. 374, Institution of Mining and Metallurgy, November, 1935.

[9]"Blasting With Safety Primers." *E.& M.J.*, Vol. 136, p. 235.

[10]"Mine Air Filtration." *Journal of the Chemical, Metallurgical and Mining Society of South Africa*, Vol. 35, p. 50.

[11]"Use of Airplanes in Mining and Petroleum Operations." Information Circular 6767, U. S. Bureau of Mines. Also, Aviation Number, *E.& M.J.*, November, 1935.

[12]"Small-Scale Placer-Mining Methods." I.C. 6611, U. S. Bureau of Mines. Also, "Placer Mining in the Western United States: Part I. General Information, Hand-Shoveling, and Ground-Sluicing." I.C. 6786, U. S. Bureau of Mines. Also, "Placer Mining in the Western United States: Part II. Hydraulicking, Treatment of Placer Concentrates, and Marketing of Gold." I.C. 6787, U. S. Bureau of Mines. Also, "Placer Mining in the Western United States: Part III. Dredging and Other Forms of Mechanical Handling of Gravel, and Drift Mining." I.C. 6788, U. S. Bureau of Mines. Also, "Placer-Mining Methods of E. T. Fisher Co., Atlantic City, Wyo." I.C. 6846, U. S. Bureau of Mines.

[13]"Industrial Relationship." Bulletin, the Canadian Institute of Mining and Metallurgy, June, 1935.

the Far West field. On the Far West Rand 950 miles of traverse have been completed, using principally the Askania magnetic balance for vertical intensity, and Watts' vertical variometer. Drill holes have confirmed the geological deductions from these surveys, but the commercial value of the area has yet to be proved. Magnetic surveys are also being extensively used on the Rand proper, principally for the location of the dikes. These slack on exposure to air and are particularly objectionable in shafts, where they add greatly to the expense of sinking. They are magnetic and are easily located by magnetometer surveys, which are now generally made as a part of the study to determine the location of a shaft.

Aërial transportation continues to be an important factor, not only in the development but in the operation of mines remote from waterways and railways[11].

Development of small gold mines continues at a rapid rate, and a recent survey shows 52 gold mills in Canada alone with a capacity of 50 tons or under. Sometimes these mills are intended primarily for the sampling of ore containing its principal value in coarse gold, difficult to determine by ordinary sampling methods; in other operations they are for working small, high-grade deposits.

Marked revival has taken place in placer mining. Small-scale operations are being carried on in many places, and a number of interesting small- and medium-sized plants have been put in operation[12]. In large-scale operations the most notable event has been the recent announcement by the management of Bulolo of a decision to build two dredges of unusual digging capacity. One will dig 80 ft. below water and carry a 40-ft. bank; the second will dig 115 ft. below water and carry a 50-ft. bank. This gives a total digging depth of 120 ft. and 165 ft. respectively.

Cementation is being increasingly used in mining. The Little Long Lac open fractures connecting with the lake have been successfully sealed off, and on the Rand cementation in sinking shafts is becoming almost standard practice. Radiating holes are drilled 20 to 30 ft. in advance of breaking and a 3 per cent cement solution is pumped in under 1,500-lb. pressure. After cementing, a test hole is drilled before the blasting round is put in. Under favorable conditions 150 to 175 ft. per month advance is made in the cemented part of the shaft. On the Rand the dolomite is a heavy water producer, but other formations are usually dry. By use of cementation in the wet areas the sinking conditions in the dry areas are much improved. Lake Shore mine, at Kirkland Lake, has recently completed the sinking of a shaft through tailing and lake mud by caisson methods. The caisson has been successfully sealed off at a depth of 70 ft. This shaft is to replace the present hoisting shaft, which is partly in the ore zone. It will be completed by putting up pilot raises from the levels below, followed by slashing off and timbering from the top downward.

At the Beattie mine, in Duparquet Township, Quebec, where a large body of low-grade ore is being extracted, mining is done by both surface open-cut and spiral-raise open stopes. The crushing plant has been so placed that a large part of the ore flows to it by gravity through a series of large raises. Just above the crusher the flow of ore is controlled by log gates, where large boulders are blasted before being allowed to pass to the crusher. The crushed ore passes to a belt conveyor, which takes it to the hoisting pockets at the shaft. This arrangement eliminates grizzlies and underground tramming, and has given excellent costs.

Employee relationships have been given a great deal of attention in recent years. Insurance on employees covering all non-occupational hazards is becoming increasingly popular, and in isolated camps the promotion of recreational facilities has received much attention. Even the airplane has been used to make it possible to organize mining-camp leagues in baseball, football, and hockey. The outstanding contribution on this subject is the presidential address delivered by S. G. Blaylock at the last annual meeting of the Canadian Institute of Mining and Metallurgy[13]. In this he describes a system of Coöperative Committees which for seventeen years has maintained harmonious relations between men and management.

* THE PRECIOUS METALS *

Problems in Their Recovery

Some difficulties still unsurmounted in cyanidation, despite development of methods to treat refractory ores

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GOLD AND SILVER almost invariably occur together, and although one or the other may predominate in an ore to such an extent as to classify it as either a gold or a silver ore, there is rarely a gold or silver ore in which the other metal is entirely absent. On account of this close association of the two metals, it is desirable, if not essential, that whatever process of final recovery is used be capable of saving both metals at a single step. Broadly, there are two types of processes of final recovery—that is, fire or smelting processes and wet processes.

From the standpoint of versatility and uniformly high recovery, smelting is the nearest approach to perfection. By the application of this process it is possible to recover practically all the gold and silver from any ore or concentrate, no matter how refractory. There would be no need of considering any other process except for the fact that, in smelting, certain exacting requirements must be met and the cost of plant and operation are relatively high. Therefore a less efficient process metallurgically, but one which can be applied at lower cost, frequently gives a better economic outcome.

Gold and silver ores cannot be smelted alone but require a collecting agent such as lead or copper. If the ore or concentrate is not self-fluxing, barren fluxes must be added to give a fusible slag. Additional steps of refining are required to separate the precious metals from the base metals.

It is therefore not surprising that gold and silver recovered by smelting come largely from copper and lead ores, and to a less extent from precious-metal ores and concentrates treated in such plants on account of their refractory nature or because of their fluxing value. When a refractory gold or silver ore or concentrate cannot be treated locally, therefore, it is shipped to a lead or copper smelter, where there is the proper set-up for efficient operation. This procedure would be highly satisfactory but for the economic aspects. When an isolated mine finds it necessary to ship a refractory concentrate or other intermediate product to a distant smelter for final recovery, those who are operating the property often become painfully aware of the relatively low net realization that arises through a combination of circumstances for which the smelter is generally not responsible. This has led to the constant endeavor of producers of what are primarily gold and silver ores, even when refractory, to recover these metals in the form of bullion if possible by a simple wet process which can be successfully carried out locally.

Cyanidation is such a universal process, readily applied in any location upon a small or large scale to the recovery of both gold and silver. Indeed, aside from amalgamation, which has its limitations but nevertheless may at times be a very useful accessory process, cyanidation is the only wet process of final recovery now universally used. This remarkable process is best appreciated when we consider the weaknesses of older wet processes such as the more complicated chlorination process, which recovered gold only, and some of the so-called silver processes with which the recovery of gold was painfully low. Flotation has proved valuable in the treatment of precious-metal ores, but it cannot now in any sense be regarded as anything more than an intermediate process for eliminating valueless gangue, and not as a process for final recovery of gold and silver.

Equipment for carrying out the cyanide process has long been more or less standardized, with here and there minor improvements. The process was first applied to treatment of gold ores and then extended to treatment of silver ores, and with constantly improved results on both gold and silver ores it is now well suited to the efficient treatment of the majority of such ores. Despite the attention that has been paid in the past, and is still being paid, to development of preliminary treatments which will render ores otherwise refractory to the process amenable to treatment, a few unsolved problems still await solution.

Silver in Refractory Oxidized Ores

Oxidized ores, and especially those containing the higher oxides of manganese, are frequently refractory with respect to the silver. It has long been known that an oxidizing roast would ruin the extraction of silver. On the other hand, oxidized gold ores, including those containing manganese, are in general amenable to cyanidation, and usually an oxidizing roast of a refractory gold ore will render it amenable to treatment. Two methods of preliminary treatment have been developed in the past for rendering silver soluble in refractory oxidized ores: (1) A reducing roast, generally on the coarse ore, so carried out that the higher oxides of manganese are reduced to manganous oxide and reoxidation during cooling is prevented, followed by fine grinding and cyanidation. (2) Treatment of the finely ground raw ore with a solution of sulphurous acid to dissolve all the soluble manganese, followed by washing to remove the dissolved salts; then cyanidation. In one modification of the process best suited to ores of low manganese content, filtration is avoided by precipitating the manganese and iron directly in the pulp, followed directly by cyanidation.

Either reduction or the sulphurous acid process will give a good recovery on the majority of ores if properly carried out, but the processes mentioned are supplementary operations and therefore increase the cost of treatment. Oxidized ores are frequently of low grade and therefore do not afford much margin for increased costs. What is really needed is some method or process that can be utilized at little or no increase in cost, which will improve extraction upon low-grade ores. Attempts have been made to float such ores by special methods which would eliminate gangue and give a smaller bulk of a higher-grade product which would stand more expensive treatment. Interesting results have at times been secured, but so far nothing concrete has been accomplished. Fortunately, not as much silver is tied up in such ores as was at one time supposed. Moreover, the difficulty generally disappears when the mine passes out of the zone of oxidation and the oxide minerals of manganese give way to the primary minerals. The silver in clean primary ores is rarely refractory and certainly not on account of the presence of primary manganese minerals.

Fine Grinding and Refractory Tellurides

Tellurides, the only known combination in which gold occurs in nature, were at one time held responsible for some of the difficulties in cyaniding certain gold ores and concentrates. More recently it has been found that combinations of gold with tellurium, if liberated and ground sufficiently fine, are not so refractory as was formerly thought. Despite the well-known solubility of finely divided free gold in cyanide solutions, the clearing of the record to some extent at least for tellurides, and the absence of any other known compound of gold on which to blame the difficulty, we do know that there are certain ores and concentrates in which a part of the gold does not yield to cyanidation. Gold ores containing much graphite are looked upon with suspicion. Ores containing pyrrhotite may be difficult to treat. Ores containing arsenic or antimony, or both, frequently give trouble.

Carbon and Extraction

With respect to graphite, it has long been thought that the difficulty was due to premature precipitation of the gold. The so-called graphite in gold ores may be anything from little more than amorphous carbon to more inactive forms of carbon such as graphite. Premature precipitation is more likely to occur with the more active forms of carbon. There is evidence that coating of the gold particles by the less active graphite may at times be a contributory factor. Oiling prior to cyanidation may be a palliative, but generally it is not an entirely satisfactory remedy. Unless one is willing to resort to roasting to burn out the carbon, the only other alternative is to float as much as possible of the graphite before cyanidation. The graphitic concentrate generally cannot be produced free from gold, despite the fact that originally none of the gold may have been directly associated with the graphite. Such a concentrate would require either roasting or shipment to a smelter.

Trouble From Pyrrhotite

Pyrrhotite, when present, frequently gives trouble on account of the ease with which it oxidizes and the avidity it has for oxygen. Ores containing pyrrhotite generally contain other sulphide minerals of iron and possibly also arsenic. The pyrrhotite itself may or may not contain gold. Homestake is an example of an ore containing pyrrhotite which is treated with excellent results by the liberal use of air with both the sand and slime. Pyrrhotite is perhaps at its worst at Morro Velho, Brazil (St. John del Rey Mining Company). Here, despite liberal use of air and low alkalinity, solutions can be used but once.

Sulphides with which are associated arsenic or antimony, or both, are likely to be refractory, although there is no direct evidence which explains satisfactorily why this should be so. Antimony at times may occur in a gold ore, both as sulphide and in the metallic state. Gold actually alloyed with metallic antimony could obviously not be dissolved unless the antimony with which it was alloyed was also dissolved. In respect to sulpho-arsenides of iron and antimony, sulphide occurrence of the gold would probably be the same as in the iron sulphides, which are discussed more in detail later.

Help From New Tools

New tools and the better use of old tools have done much to throw light on the mode of occurrence of gold in sulphides. Among these may be mentioned the microscope, the spectroscope, Haldane's super panner, and procedure recently developed in my laboratory by Creglow for making sink-and-swim tests in heavy solutions upon fine material by means of the centrifuge. It is now thought that the gold in sulphides is all present as metallic gold, the size ranging from what might be regarded as colloidal upward. It also appears that at least part of the gold particles may at times be covered by coatings. Much remains to be done in identifying and determining the characteristics of these coatings and how to prevent their interference with the recovery of gold either by flotation or cyanidation. Iron oxide is perhaps the most frequent, with possibly even silica and other compounds of unknown composition less

common. One might with reason assume that coatings should be worn away from the malleable gold during grinding, exposing it to attack of the solution. However, some of these coatings are very resistant, and it is also possible that coatings may at times be developed during grinding. Gold particles ½ micron and possibly even down to 1/10 of a micron are now readily identified under the microscope. Such a particle is very small compared to the finest screen now available. The opening in a 200-mesh screen will measure about 74 microns and in a 323-mesh screen, about 44 microns. It is not unusual to find particles of gold within relatively large grains of pyrite, after what may be regarded as very fine grinding, most effectively protected from contact with the cyanide solution. No doubt there are the two factors: particles of gold so fine that they are entirely protected by the pyrite and particles which may be liberated, but are coated. Consequently, the solutions cannot in either condition come into contact with them.

Fine grinding has perhaps been the greatest single contributory factor to better recoveries of gold and silver by cyanidation, but there is a limit beyond which it is not practicable to go, both on account of the cost of grinding and difficulties which may arise in settling and filtering extremely fine material. In fact, some plants employing extremely fine grinding of concentrate have about reached the limit of what they can filter. Reduction in the vacuum has under some conditions been helpful. There is, therefore, clearly a limit to what can be accomplished by fine grinding. An oxidizing roast, where the grade warrants it, may be a satisfactory preliminary treatment, but this is an added cost and involves a hazard of loss. Roasting is frequently critical and improvement in recovery of gold is sometimes not as good as desired. Although the field for cyanidation has been greatly broadened, there still remain some conditions concerning which we must admit that the ore or concentrate cannot be efficiently treated.

If one must ship refractory concentrate to a smelter, it is important that a high recovery be made from the crude ore and that, at the same time, a high-grade concentrate be produced therefrom, to reduce cost of transportation and marketing. A high recovery and a high-grade concentrate do not always go together. In some operations a low tailing can be secured only by making a considerable amount of low-grade middling for which there may be no satisfactory treatment or outlet. Fine grinding of a middling to permit recovery from it by flotation of a concentrate of satisfactory grade may actually liberate gold particles from the pyrite which are not recoverable by flotation, on account of a coating. These were floated originally because they were attached to pyrite in the gangue, but they are not recoverable once they are detached on account of the coating.

Doré bullion in which silver predominates, and gold bullion in which gold predominates, regardless of whether they are produced by smelting or cyanidation, have the same characteristics and are separated and purified by the same processes. Precious-metal refineries employing either the acid or electrolytic process are in general operated in conjunction with copper and lead refineries. It would not pay the average cyanide plant to operate such a refinery, but one notable example of an electrolytic parting plant operated with a high degress of success in conjunction with a cyanide plant is that of Cia. de Real del Monte y Pachuca, of Mexico, which operates exclusively upon its own doré bullion and custom bullion of a similar character produced by other cyanide plants.

Discussion of the refining of gold and silver in detail is not within the scope of this article, but one old process of gold refining which has not been previously used commercially in the United States merits attention because, where applicable, it appears better suited to local use than some of the more generally used processes of refining. I refer to chlorine refining. This process was first introduced into Australia by Miller and has been in use at the Canadian Mint for some time. The process is simple in principle and application and it is suited to the refining of gold bullion of about 700 fine or higher. Gaseous chlorine is passed through a clay tube into the molten bullion held in a clay crucible, heated in a suitable furnace. The chlorine combines with the base metals and silver, forming molten chlorides, which are ladled out of the crucible. The operation cannot be carried on in a graphite crucible, on account of the reducing action of the carbon on the silver chloride. Inasmuch as the clay crucibles frequently crack, it is necessary to place them in guard crucibles of graphite. The difficulty of manufacturing large clay crucibles which will not crack limits the size of the individual charge to about 600 oz.

Clay tubes and crucibles are imported. Even with clay crucibles of the best quality there is frequent breakage, which with skillful manipulation, and on account of the guard crucible, does not result in loss or a great deal of inconvenience. Liquid chlorine now available in cylinders has eliminated the troublesome generator. Aside from this, the process with one exception remains the same as has been used for years. The description writen by Percy many years ago could not be improved upon and might well be used to describe the process as carried on today. The Homestake company is using the process to refine all of its gold production and other companies are reported to be considering adopting it.

The United States Smelting, Refining & Mining Company was among the first to take up the process for the direct refining of Alaska placer gold, for which the process is very well suited. Special graphite crucibles with clay liners are used. These permit of larger charges and do not require a guard crucible. This results in greater convenience and a reduction in costs. This is the only improvement that has been made in the original process. It has been the practice in Australia and elsewhere in the past to have no recovery system on the flue gases other than a scrubber. My experience is that there is a small loss if a baghouse or other means for efficient recovery is not provided. Moreover, there is the problem of recovering entrained gold from the chloride and separation of the silver and conversion of it from the chloride into fine metallic silver. The process is therefore not quite as simple as it appears. In view of the low charges made by government mints for refining gold bullion of the type that can be handled by the process, local refining would not appear to offer any advantage except where there was a large production.

A glimpse of Pachuca, 1936

* FLOTATION *

Application to Non-metallics

Separation of oxidized minerals by differential air levitation with oil has interesting and important commercial and industrial possibilities—The outlook.

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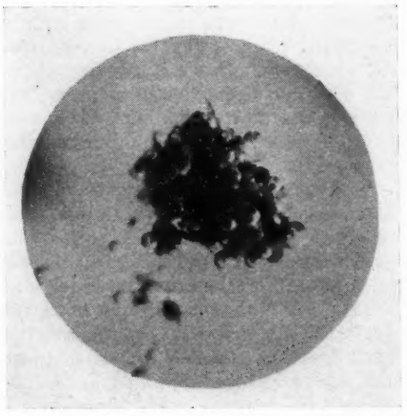
TRIAL of two patent cases[1] recently held in the United States District Court at Wilmington, Del., marks, in its way, the beginning of serious commercial interest in the separation of non-siliceous oxidized minerals from siliceous oxidized minerals by the familiar process of differential air levitation through the use of oil, applied to a mixture of such minerals.

The Christensen patent, which was issued in 1923, describes this kind of separation generally. The Chapman and Littleford patent, issued in 1934, claims specifically the use of shaking tables in effecting separation of air-levitated aggregates of non-siliceous oxidized minerals from their gangues, and makes its particular application to Florida phosphates.

The rule that Christensen sets forth for the separation of oxidized minerals is to use as a collector an acidic substance that can react with the mineral to be collected to form an insoluble water-repellent coating thereon, and to do this in a pulp that has been freed of electrolytes that will inhibit such a reaction or the resultant selective air levitation. Chemically, the collectors recommended are organic acids such as the fatty or resin acids, or compounds of these, such as the soaps.

Christensen's discovery as to the nature of the phenomenon underlying oil-coating of non-siliceous oxidized minerals was later found to apply also to sulphide flotation.[2] Modern sulphide flotation has settled down to the use of collectors typified by the xanthates and the so-called "Aerofloats." These are salts of other organic acids, specifically the di-thio class, characterized by the polar group —$CS5^{-}$. Their utility in sulphide flotation lies in the fact that the heavy-metal (Pb, Cu, Zn, Fe, etc.) salts of those acids having more than two or three carbon atoms in the radical are substantially insoluble in water and in relatively dilute solutions of acid and alkali, while the alkali and alkaline-earth salts are soluble.

In the fatty and resin acids the polar group is carboxyl, —COO^{-}. The resin acids all have many carbon atoms in the radical, but in the fatty-acid series there is a regular integral gradation upward from one-carbon-atom formic acid. The salts of these two groups with the alkali metals are soluble in water, but the "resinates" and the fatty-acid salts (soaps) containing upward of seven carbon atoms of both the heavy metals and the alkaline earths are substantially insoluble in aqueous solutions, again throughout certain pH ranges. The pH range for stability and insolubility of the alkaline-earth soaps, however, is much narrower than that for the heavy metals. Thus, while



AN AIR-LEVITATED FLOCCULE of Florida phosphate. × 15

copper minerals can be floated with oleic acid ($C_{17}H_{33}.COOH$) in both acid and alkaline pulps, if the pH is not too far off 7.0, calcium minerals float only on the alkaline side of pH = 7.0. This is to say that hydrogen ion in excess inhibits flotation of the non-metalliferous mineral.

Explanation for this lies in the fact that, in so far as the di-thio acids are concerned, they are strong acids, and free acid ions can exist, barring actual decomposition, even in the presence of an excess of hydrogen ion introduced by strong inorganic acids. Furthermore, their heavy metal salts precipitate in the presence of, and are not decomposed by, moderate excesses of hydrogen ion. The resin and the higher fatty acids, on the other hand, are, judging from the values for the lower members of the fatty acid series, weak acids, only slightly ionized in chemically neutral water (pH = 7.0), and even this slight ionization is substantially suppressed by any considerable excess of hydrogen ion in the pulp. Notwithstanding, there is enough ionization at the surface of fatty-acid droplets in acid solutions to permit sufficient reaction between the fatty acid and heavy-metal minerals to promote spreading of the liquid acid (or of an oil containing it) on the mineral-particle surface. This, because the heavy-metal soap is relatively insoluble and stable in, and can therefore form in, an acid pulp. The coating is slow, however, both on account of the low ionization of the collecting acid and the difficulty of dispersing it in an acid pulp.

On the other hand the soaps of the alkali-earth metals are not, in general, stable in the presence of excess hydrogen ion. Hence reaction either does not occur when contact is made between a fatty-acid droplet and such a mineral in acid pulps, or it is very slow, and consequently coating does not take place.

The pH range throughout which a heavy-metal sulphide may be floated depends upon both the mineral and the collector and may lie wholly in the acid or wholly in the alkaline range or may embrace pH = 7.0. The range for the oxidized non-siliceous minerals with fatty- or resin-acid collectors is always near pH = 7.0, and maximum flotation will generally lie within the range delimited by clearly acid and clearly alkaine reactions to litmus paper. Free acidity or alkalinity and not the titratable quanties of acid and alkali are the important quantities when the two are different. Most ores consume—that is, permanently neutralize—either mineral acid or alkali or both, so that the quantity necessary to produce a given pH, rather than that calculated to produce the same pH if added to chemically neutral water, must be used.

Various other differences exist between the conditions prevailing in successful heavy-metal mineral flotation and those favorable to flotation of alkaline-earth minerals.

Unlike sulphides, the non-metallic minerals will not, in general, float well with-

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[1]Phosphate Recovery Corporation vs. Southern Phosphate Company on the Chapman and Littleford patent, No. 1,968,008; and Southern Phosphate Company vs. Phosphate Recovery Corporation on the Christensen patent, No. 1,467,354.

[2]Taggart, Taylor, and Ince: *Trans.* A.I.M.E., 87,285 (1930). Taggart, Taylor, and Knoll: *Trans.* A.I.M.E., *Ibid.*, 217. Taggart, del Giudice, and Ziehl: *Trans.* A.I.M.E., *112,348* (1934). Gaudin, A.M.: *Min. and Met.* 10, 19, (1929)

[3]Martin, H. S.: *Trans.* A.I.M.E. 112,466 (1935) Burr, J. A.: *Ind. & Eng. Chem.* 26,811 (1934).

[4]Miller and Breerwood: A.I.M.E., T. P. 606.

[5]See G. R. M. del Giudice: *Trans.* A.I.M.E., 112,398 (1934)

out the presence of an insoluble coating oil in the pulp. Petroleums are generally used, the sequence of steps in oiling being: first, reaction between the organic-acid radical of the collector and the mineral, to form a water-insoluble coating compound, and thereafter oil-coating of the thus altered surface. Addition of the collector acid in solution in the insoluble oil has the further advantage that it holds back saponification of the fatty or resin acid, and thus introduces the organic-acid radical in ionized form and at a rate, substantially, no faster than the mineral can consume it. There is, thus, little wastage of the fatty acid, and the evil effects of excess of soluble soap (over-frothing) are avoided.

Iron ions apparently form reaction products with quartz-particle surfaces sufficiently insoluble to cause precipitates thereon in pulps where even moderately strong oxidizing conditions prevail, and this precipitated iron compound may react with the collector and cause oil-coating and consequent flotation of the quartz. When the source of ionic iron is metallic iron introduced in grinding, the effect is not, in general, harmful unless the quartz is visibly stained. Visible staining can be prevented by having present an acid ion that will precipitate the iron before it has an opportunity to react with the quartz. It is interesting to note, in this connection, that phosphate ion dissolved in Florida phosphate pulps acts as its own iron corrective in the flotation of these ores[3], and that carbonate ion in the calcite pulps at Valley Forge Cement Company[4] probably does the same thing.

Action of Ferric Salts

Without such natural correctives, an operator is faced with the alternatives of finding a precipitant suitable for introduction into his particular pulp, or of grinding out of the presence of iron. Ferric salts, such as $FeCl_3$, activate quartz without visible staining.

Desliming, in the present state of our knowledge, is markedly helpful in nonmetallic mineral flotation. In this respect we are paralleling early sulphide flotation experience. It is probable that the causes are the same—namely, that certain slimes form reaction products with a free ion at the mineral particle surfaces that cement the slime particle to the mineral[5], and also that the slimes collect at the oil-droplet-water interfaces and in both places prevent smearing of oil onto the mineral particles. Where the slimes are worthless, as in Florida phosphate practice, desliming is the indicated remedy. At Valley Forge the slimes are reintroduced into the calcite concentrate after flotation, in proportions to give a chemically suitable slurry for clinkering. But where slimes cannot be discarded, conditioning to render either the slime or mineral particle too insoluble to permit the cementing reaction, as is pointed out in the paper by del Giudice, is indicated.

* HEAVY FLUID SEPARATION *

New Efforts Offer Promise

Use of cheap suspensions will make beneficiation easier where specific gravity differences are small and large sizes must be treated at low cost

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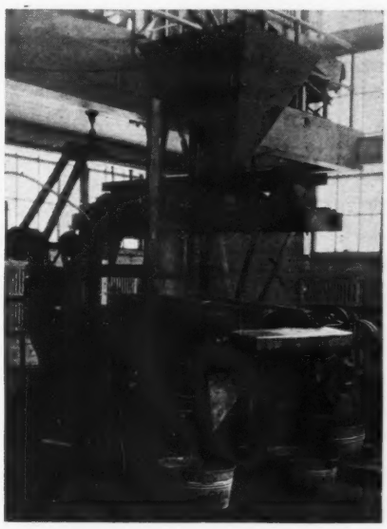
RECENT DEVELOPMENT in the use of heavy liquids in the preparation of minerals has been in two general fields; first where the media are heavy liquid chemicals, or solutions having a high specific gravity; second, where they consist of suspensions of more or less finely divided solids in water. The second group can be subdivided on the basis of methods of maintaining the suspensions and methods of making the separation.



EQUIPMENT employed in the following flowsheet used in heavy media separation work in laboratory of Michigan College of Mining and Technology. The bin, feeder, jig, trommels, suspension tank, and pump are shown

In ore-dressing and mineralogical laboratories heavy chemicals and solutions have long been in general use for separating minerals. Many such liquids have been developed for this purpose, and the technique of their use is generally known. Their commercial application has, however, been beset with difficulties. Not only does the recovery of these liquids from the wash solutions require an evaporation or a distillation process, but most of them are expensive and difficult to prepare.

In the preparation of coal, however, several relatively cheap solutions can be used, because for this purpose a specific gravity of from 1.4 to 1.8 is sufficient. This density can be obtained in the solutions of the chlorides of iron, calcium, barium, or zinc. The laboratory investigation of the washability of coal by means of these solutions dates back about 80 years, to Bérard. Immediately after the publication of the details of his work, many different processes were patented covering the use of these solutions in coal washing. Some of these were tested in actual plant practice, but were abandoned as uneconomical.

Interest in these solutions has been revived by the recent work of Lessing in England. His process consists of separating the coal, after thorough dedusting, by means of a solution of calcium chloride in a tall vessel with a tapered base. The clean coal floating on the surface is removed by an endless-belt scraper into vertical cylinders, and the refuse is removed by a screw conveyor from the bottom of the separating vessel into other cylinders. The products are allowed to drain in these cylinders, and thus most of the heavy solution is recovered and goes back to the separating vessel. Then the products are washed with water by downward displacement. Thus the amount of solution to be concentrated is kept within reasonable limits.

Theoretically this process should be able to handle an unsized feed, but actually there is difficulty in treating the finer sizes because of the high viscosity of the concentrated solution necessary to obtain the required specific gravity. For coals in which the separation must be made at densities higher than 1.4, a rising current becomes necessary; and the process then departs from a pure sink-and-float separation.

Both the reported loss of calcium chloride in the products and the amount of solution requiring concentration are rather low. For some of the German coals the estimated cost of this process is approximately twice that of the jigging processes. The separation is, however, so much more efficient that with difficult coals the process has a decided advantage.

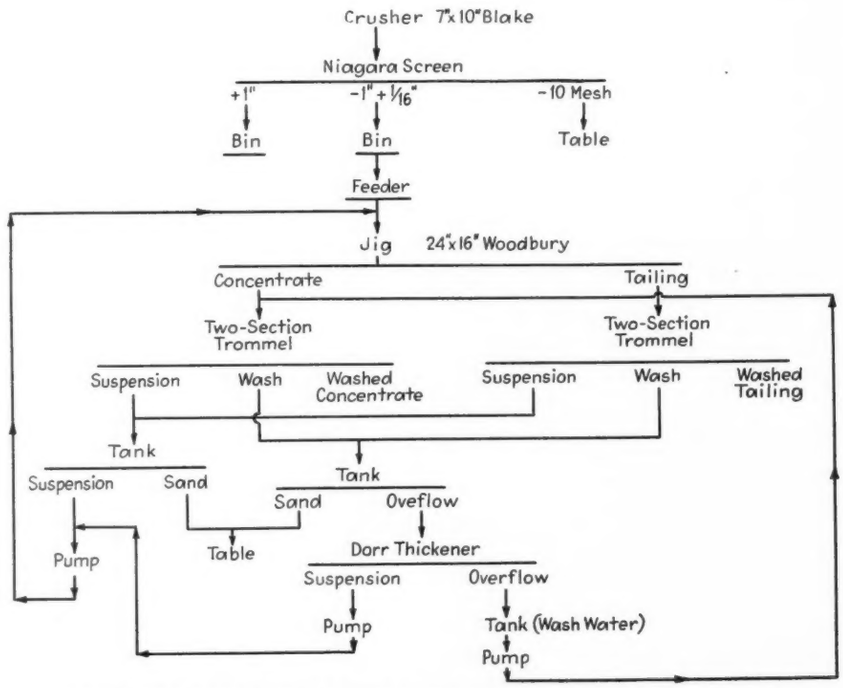
For general ore dressing by the sink-and-float method the only heavy chemical that has been seriously considered is acetylene tetrabromide, which has a specific gravity of 2.94 when pure. Lower densities can be obtained by diluting the tetrabromide with carbon

tetrachloride, acetone, or even kerosene. But the practical application of this chemical, even according to the most optimistic promoters of the process, depends on producing it for less than 10 per cent of the present market price. Moreover, in addition to the original cost of the chemicals there are several technical difficulties that must be solved before this process will be successful.

Some of the advantages over the first group possessed by the second group of processes—those in which suspensions are used as media—lie in the small original cost and in the ease of recovery of the media. The materials for the suspensions may be sand, galena, barite, clay, or iron ore more or less finely divided. Most of them can be readily thickened from the wash solutions, and the properties of the recovered from the wash water.

Another development for coal preparation is the De Vooys process, which is in practical operation at the Sophia-Jacoba mine, at Hueckelhoven, Germany. In this process the medium is a mixture of finely ground clay and barite suspended in water. The two constituents are so proportioned that the suspension shows very little settling under the operating conditions. Heating is necessary to keep the viscosity down to practical limits.

The separation is made in deep tanks by a true sink-and-float process. Floating coal is removed by scrapers from the surface; the "sinks" are elevated by buckets from the bottom. The products are washed by water sprays and the suspension is recovered by thickening. Total cost for the actual separation is



EFFECTIVE SEPARATIONS have been accomplished with this flowsheet on iron ore ranging in size up to 2 inches and on copper rock up to 3 inches, using heavy suspensions made of finely ground iron ore in water

thickened suspensions can be controlled by heat, chemicals, and colloidal additions.

The disadvantages lie in the natural tendency for all suspensions to settle or to stratify. Agitation of any sort will produce eddy currents which have an adverse effect on the absolute efficiency of separation. This last consideration, however, has been overemphasized, for by actual tests in well-constructed apparatus results are close to those obtained by actual sink-and-float separation.

The Chance process, in which sea sand between 40 and 60 mesh is kept in suspension by a rising current of water, has been in general use in the preparation of coal for about fifteen years. Because of its relative coarseness, the sand used can easily be about the same as for jigs. This process is being introduced into England for the cleaning of difficult coals.

In the Wuensch process for general ore dressing the separating medium is a suspension of finely ground galena. The separating vessel resembles the Chance machine in general outline, but the sorting column is adjustable. The suspension is stirred by paddle arms; but, since no rising current is used, the actual separation is by sink-and-float, each particle finding its place according to its specific gravity.

In the application of general ore-dressing methods to Michigan iron-bearing formations it early became evident that more efficient methods of separation were necessary than those in use. Not only were the differences in specific gravity between the component minerals much less, but the liberation on crushing was much poorer. In the effort to obtain about the same efficiency of separation that was possible by the sink-and-float methods, the various suspensions and heavy solutions were investigated. The most practical of these for the purpose at hand seemed to be the suspension made of finely ground iron ore. The efficiency of a sink-and-float separation had to be sacrificed somewhat to the cheapness of the suspension and the ease of its manipulation. With machines of the same type as are used in gravity concentration with water, results have been encouraging. Efficiencies up to 98 per cent of those by sink-and-float separation have been obtained. Sizes up to 2 in. in iron ore and larger than 3 in. in copper rock have been separated easily.

To confirm the results, the accompanying flowsheet was set up, with a capacity of from 1 to 2 tons per hour. A number of tests lasting from 6 to 8 hours were made on iron ore and copper rock. No difficulty was experienced with the suspension, which even after a two weeks' shutdown could be drawn off from the Dorr thickener. Most of the coarser sand picked up from the feed was deposited in the tank which received the wash from the trommels, and some also settled out in the tank holding the reserve suspension.

Draining and washing of the products were done in two-section trommels covered with 10-mesh screen. The loss of medium could be easily kept to 2 or 3 lb. per ton, and the overflow from the thickener, which was used as wash, contained less than one-half gram of filterable solids per liter. The only loss of water was in the products.

In most of the tests the minus-10-mesh fraction was screened out. This is not absolutely necessary, as this part of the feed could be caught as a hutch product and cleaned on tables. In the more difficult ores, however, the plus-10-mesh also should be sized to two to three fractions; but where the liberation is fairly good, sizes between 1 in. and 10 mesh can be treated without screening.

Tests with the copper rock showed that under some conditions it would be possible to reject at 2-in. size from one-half to two-thirds of the feed without serious loss of the metal.

Heavy-fluid processes will find their place in ore dressing for the purpose of making difficult separations and for the treatment of material that must be concentrated cheaply and at fairly large sizes. They can also be used for the preliminary enrichment of feed. The ore-mineral association is often such that this method will reduce materially the amount that will have to be ground for the final concentration.

* ELECTROMETALLURGY *

Forges Ahead

New developments in aluminum, copper, lead, zinc and cadmium outstanding features of 1935

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WITH respect to aluminum, developments were many and world wide in 1935. Almost every country has been planning to produce within itself tonnage at least sufficient for domestic consumption. The French, German, and Italian governments have been aiding efforts to expand the use of aluminum at the expense of copper, of which they lack ore reserves. On all sides, work is going on to produce large amounts of aluminum metal from raw materials other than bauxite.

Reports indicate that the U. S. S. R. reached its figure of 25,000 tons production in 1935; a 50 per cent increase is planned for 1936. The Dnieper plant uses a thermo-electric method for producing its alumina. It was expected to produce over two-thirds of the 1935 output, the rest coming from the Volkhov plant, near Leningrad. Operation of these two plants in 1936 is expected to benefit from the experience of foreign firms, particularly from the French. A third plant, to produce 25,000 tons of aluminum annually, has been started on the river Iset, in the Central Ural district. Figures for 1935 productions are expected to show the U. S. S. R. second only to Germany in aluminum production among European countries.

Direct production of aluminum alloys in the aluminum producing baths has grown in favor.

No major improvements in the electrometallurgy of aluminum were reported. The electrolytic oxide coating of aluminum and its alloys by the Aluminum Company of America's Alumilite process made further progress. Anodic oxide coatings can be produced from 0.1 mil to 1 mil in thickness. They are hard and resistant to weather and can be colored. Technical progress has been in improving the protective effect, appearance, and in standardizing production. The article to be coated is made the anode in a special acid electrolyte. A current of 12 amp. applied for 10 to 60 minutes will yield a coating 0.1 to 0.6 mil in thickness. The original coating is porous and adsorbent to dyes and pigments. The subsequent sealing step renders the coating impervious without harm to the color.

February, 1936, marks the fiftieth anniversary of the first production by Charles M. Hall of aluminum by the present methods.

The Bureau of Mines has been working on obtaining alumina from Western alunites by electric-furnace treatment, the alumina forming a fused oxide, the silicon volatilizing as sulphide and the potash as K_2O, the iron forming ferrosilicon containing a little alumina. The silicon sulphide burns to form an exceedingly fine SiO_2, which has potential uses.

Copper—The year saw the completion of the Rhokana Corporation's Nkana electrolytic and furnace refinery in Northern Rhodesia. It has a capacity of 100 short tons of wirebars per day. Converter copper is transferred to a cylindrical holding furnace in which it is given the necessary refining and cast into anodes on a Walker casting wheel. The tank house is of the multiple type, with the Walker system of tanks, and is designed for maximum power efficiency. The furnace refinery has a single 200-ton refining furnace served by a Clark casting wheel. Design, supervision of the final stages of erection, and bringing the plant into operation were by the A. E. Wheeler organization.

Late in the year, Inspiration Consolidated started its leaching and electrolytic plant, after having been shut down since June, 1932. Chile Exploration increased the proportion of lead-antimony anodes to Chilex anodes, evidently finding it advisable to do so as lower iron and nitric acid contents of the electrolyte permit.

Electrolytic refining of scrap copper became more general during the year, and all the large domestic copper companies having refineries are now doing so on substantial scales.

Preliminary studies have been made and steps taken by International Nickel Company to provide for the electric melting of cathode copper at the Ontario Refining Company plant, Copper Cliff.

The Pyshma electrolytic refinery, near Sverdlovsk, U. S. S. R., was reported near the end of the year as producing at the rate of 50,000 tons per annum, and is to produce double that at full capacity.

Lead—An important development in lead is the steady operation of the first unit of the Cerro de Pasco electrolytic lead refinery and carrying ahead of the program for a 100-ton plant, to be operating in 1936. It is evident the modification of the Betts process worked out by Cerro de Pasco for refining impure lead has proved a noteworthy success and applicable to large-scale operations. The first unit, designed for 25 tons, has averaged about 28 tons of lead per day. Purity of product is above 99.99 per cent. The anodes analyze about 90 per cent lead and may be as low as 80 per cent, with antimony, arsenic, and bismuth being the major impurities. Treatment is made economical by providing a simple set of operations for a four-day anode life on 90 per cent lead (two days for 80 per cent lead) and countercurrent washing of slimes without removing these from the anodes. The critical voltage at which impurities begin to deposit with the lead is about 0.2 volt.

Trail is reported as continuing its practice of separating a high bismuth lead from the blast-furnace product by the use of zinc and treating the high bismuth lead by the Betts process.

Another important development was the restarting early in 1935 of the Betts process refinery of the U. S. S. Lead Refinery, Inc., at East Chicago. This plant was supposed to have been shut down permanently in favor of the Parkes process refinery at Midvale, Utah. Apparently, the continued demand for high-purity metal was a factor in reopening and continuing the electrolytic plant. Operations are stated to be conducted as before the shutdown.

Zinc—Late in 1934 the electrolytic plant at Magdeburg, Germany, started up. The plant has a capacity of 40,000 metric tons of zinc per annum. The cell room embodies a number of differences from previous practice. The number of cells per unit is much higher—240 cells in each of two units. Current density is about halfway between high- and low-current density practice, 65 to 70 amp. per square foot. The cell acid return contains about 160 grams per liter acid and 60 grams per liter zinc. The anode is somewhat similar to the Tainton anode. Only one instead of two is used for each cathode, and there is no circulating of electrolyte. The stripping of cathode zinc is carried on continuously. It is melted in an induction furnace, a promising departure from previous practice.

In 1934 the first electrolytic zinc plant in the U. S. S. R. was built at Ordzhonikidze, in the Caucasus. The local raw material is a zinc concentrate made from a lead-zinc ore. This year the second was built at Cheliabinsk, in the Urals, with a zinc concentrate made from copper-zinc ores as the local raw material. Both were designed for a capacity of 20,000 metric tons of zinc per year. Mercury-arc rectifiers were planned for converting direct current for the cells. The plants were reported on, designed, and built under the supervision of American engineers engaged by A. E. Wheeler.

Early in 1935 it was stated the Electrolytic Zinc Company of Australasia, Ltd., would start up its new unit at Risdon, Tasmania. This would increase

annual capacity from 54,000 to 70,000 long tons of zinc. It was to operate on accumulated stocks of concentrate for about a year, and operation thereafter was to depend on whether metal prices would warrant opening the company mines in Tasmania. More general use of the alkaline circuit in flotation at Broken Hill has changed the composition of the concentrates and may invite some modification of the zinc-plant flowsheet.

Vieille Montagne built an electrolytic zinc plant of 6,000 metric tons' annual capacity at Baelen-Wezel, Belgium. The Norwegian plant is reported to have installed equipment to increase production. Italy built a small plant (Montecatini-Montevecchio interests) at Marghera, near Venice, with a capacity of 10,000 metric tons of zinc per annum. One was reported to be built in Japan.

The Hudson Bay Mining & Smelting Company installed additional equipment to take care of excess zinc concentrate, which has been piling up. Trail continues to lead all in tonnage produced.

With this world-wide activity, purity of product has been raised, so that 99.98+ is stated without enthusiasm and 99.999 aimed for.

Electrogalvanizing involving the direct use of leaching-plant solution is coming into large-scale operation. The Bethlehem Steel Company is building a 250-ton wire-galvanizing plant at Johnstown, Pa., after operating a pilot plant about one-fifth of that in size near Baltimore. The Tainton process, with a current density much higher than in Tainton zinc-plant operation, is used. Cleaning the wire is also done electrolytically, it being passed through a molten alkali bath in which it is the cathode. Nascent sodium is liberated, which reduces any oxides and produces a clean surface for the subsequent electrogalvanizing.

In electroplating, "bright" zinc is being stressed. The trend is toward high-purity zinc anodes and higher current densities. The Grasselli Chemical Company is using 35 amp. or more per square foot in an alkaline-cyanide-zinc solution.

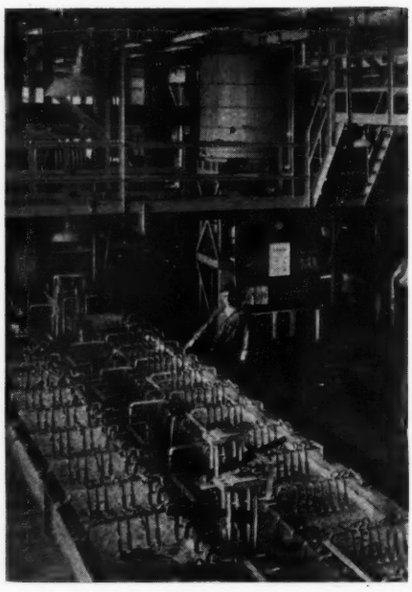
St. Joseph Lead Company's electrothermic zinc smelter continued to produce zinc oxide during the year. To reduce breaking off of electrodes in the furnace these are being vacuum-treated to absorb a binder. A lining of low-alumina, low-porosity bricks was found best for these furnaces. It was found that a magnesite lining carried much of the current at high temperatures. Tests showed a sharp decrease in the electrical resistance of magnesite brick near 1,200 deg. C. Work has been going on with a view to producing zinc metal at this plant.

Cadmium—Insistent demand for cadmium exceeded the supply much of the year. Electrolytic zinc-plant residues are an increasingly important source, and yield their cadmium to electrolytic treatment. Such a plant was completed at Magdeburg with a capacity of about 150 metric tons of cadmium per annum. Unlike the zinc plant, the cadmium cells at this establishment have rotating cathodes. The U. S. S. R. is also continuing to produce cadmium electrolytically from electrolytic zinc plant residues. Hudson Bay is building an electrolytic cadmium plant at its zinc plant, and has quite a stockpile of cadmium-bearing residue on which to draw. Cadmium production at the Great Falls and Kellogg zinc plants will no doubt show an increase for 1935, as will electrolytic zinc plants in other countries which have cadmium plants.

Nickel—The output of nickel has been materially increased to take care of demands, but no major developments in the metallurgy were reported in 1935. The addition to the smelter of the International Nickel Company is to meet market requirements for nickel rather than copper. The company installed the second 15-ton three-phase arc melting furnace at its Huntington, W. Va., rolling mill early in the year. Falconbridge Nickel Company reports continued improvement in operating details at its Norwegian electrolytic plant.

In the field of electroplating, stress has been laid on "bright" nickel plating. Quite heavy deposits can be laid and used without final buffing, provided some polishing is done before plating. These deposits are also said to result in greater throwing power when chromium plating is laid down on "bright" nickel.

Tin—The past year saw much agitation for the establishment of a domestic tin industry in the United States. In my opinion the production of a pure tin from complex ores, such as those from Bolivia, by electrolytic refining, offers no insoluble difficulties. The International Tin and Development Council brought out several good reports.



ELECTROGALVANIZING CELLS. Bethlehem Steel Company is building a 250-ton wire galvanizing plant at Johnstown, Pa., after operating a pilot plant near Baltimore. The Tainton process with a current density much higher than in Tainton zinc plant operation is used

Magnesium—Magnesium, the third most abundant engineering metal in the earth's crust, remains a one-company product in the United States, with an expanding field before it. The Dow Chemical Company offers a typical analysis of 99.938 per cent (by difference), produced by its method of electrolyzing molten anhydrous magnesium chloride. Present consumption of the metal is given as about 4,000,000 lb. per year. Considerable work is going on abroad, in Austria and Japan and elsewhere.

Manganese—The Bureau of Mines reports it has electrolytically produced a pure, coherent, and malleable deposit of manganese and is working toward making such a process commercial.

Ferrochromium and Calcium—In working on the production of high-grade ferrochromium from low-grade Western ores, the Bureau of Mines has been considering the possibility of decarburizing the ferrochromium by metallic calcium, the calcium to be produced by electrolysis of fused chloride. A deposit of calcium chloride is stated to have been found near Boulder Dam.

The desirable qualities of lead containing 0.1 per cent of calcium are leading to larger production of calcium.

Beryllium—Production of this useful metal is still retarded by lack of raw material. Direct production of beryllium alloys (copper, nickel, or iron) in an electrolytic cell with fused bath should yield operating advantages.

Iron—Production of alloys containing as low as a few one-hundredths of 1 per cent of some metals is stimulating the work toward the commercial production of electrolytic iron. An extended search of past work showed that much of it was done without considering that in a commercial plant the quantities of raw material and solutions handled would be large and that the operations would have to be simple for a comparatively low-cost metal like iron.

Other Metals — Electrometallurgical developments have also been taking place in the treatment of such metals as gallium, germanium, indium, lithium, sodium, thallium, titanium, tungsten, and vanadium.

In a more extended article, added space could be given to the continued trend toward direct production of alloys in the electrolysis of molten baths, and the electroplating of a wide variety of alloys from aqueous baths.

I wish especially to thank those who have helped to make this review something more than a mere repetition of information published during the year. Among them were C. M. Chapin, Jr., G. H. Clamer, S. K. Colby, C. V. Drew, J. W. Finch, and O. B. J. Fraser.

* EQUIPMENT *

Under the New Deal

Two and a half years of activity reflect manufacturers' efforts to capitalize the new-found prosperity of gold miners and the need of others for economy

THOUGH the industries manufacturing heavy equipment have lagged notoriously in their recovery from the depths of the depression, compared with some other more fortunate lines of industry, a scrutiny of their achievements in the mining, milling, and smelting field in the last two and a half years — approximately the period of the New Deal (for want of a better name)—shows in the products turned out that some progress has been made. Alertness to capitalize the advance in price of the precious metals, and a parallel ingenuity in devising offerings attractive to operators lean of pocketbook and desirous of cutting costs, have been born of the time. Nevertheless, invention has undoubtedly been curbed by limitations of capital on the part of both maker and user of machinery. Brief summaries of the situation in the major lines of mining and metallurgical equipment follow:

Dredging—The 75 per cent increase in the price of gold stimulated the working of gravels previously considered uneconomic, and dredge designers rose to the occasion. Under the new conditions leaner gravels can be worked along with those of better grade, above or below, calling for machinery of greater digging range. Yuba Manufacturing Company turned out a boat that digs successfully 112 ft. below water level, meeting the resultant problem of distributing properly the weight of the longer and heavier bucket line by means of an idler devised by O. B. Perry. This has demonstrated its efficiency in increasing the life of bucket-line parts and tumbler wearing plates, permitting use of lighter buckets and pins. Operators using it recommend it where the digging depth below water exceeds 60 ft. To secure necessary strength for large units, alloy steels have been used to a greater extent and, in general, dredges are being built for more rugged service.

Design of sectionalized dredge hulls made up of small pontoons has also been developed by Yuba to a practical point. Arrangement of the pontoons in relation to the complete hull has been studied and improved. This type of hull is being used increasingly in sizes ranging from 2½- to 9-cu.ft. bucket capacity. It has a high salvage value, and, moreover, because it can be dismantled and moved to another deposit, it makes feasible the working of many small areas previously beyond the economic margin. Likewise, to facilitate airplane transportation, many dredge units have been re-designed.

Speaking generally, with respect to dredge control, the Yuba company holds that manually operated boats are better for ordinary work than those controlled with auxiliary, air, or electrical equipment, and cost less.

Rivetless-type bucket lips, which facilitate changing lips without taking the bucket from the line, have been introduced by the Taylor-Wharton and American Manganese Steel.

Use of variable-voltage drives on placer dredges by the Natomas Dredging Company represents a distinct departure from the usual practice, according to the General Electric Company, a modified shovel-type, variable-voltage drive being used on the bucket elevator and on the two swing winches.

For operating medium-size placers, increasing use has been made of the combination of a power shovel or dragline (or both), working on land and delivering gravel for screening and washing to a plant carried either on a barge or scow, which floats on the pond and also stacks the tailings, or on a crawler mounting for all-dry-land operation.

In some installations the washing plant is segregated from the screening and stacking plant. Among makers or suppliers of such equipment in whole or part are the Link-Belt Company, New York Engineering Company, Thew Shovel Company, and others. In Colorado, a large all-dry-land installation, of this general class, which was supplied by Link-Belt, is excavating and screening gravel and stacking the refuse, the screen undersize, which is of relatively small bulk, being subsequently washed in sluices. Washing plants of the sort described include varying combinations of feeders, trommels, scrubbers, conveyors, sluice boxes, and riffle pans; also tables, jigs, and centrifugal concentrating devices.

Washing Gravel—Many machines, wet and dry, and attempting to utilize various principles of concentration, have been devised for recovering gold from gravel. The claim is made for most of them that they recover the fine gold—a claim that can often be questioned. Among them is the so-called "Desert Sluice," economical in use of power and water, devised by G. W. Rathjens and made by National Equipment Company, of Salt Lake City. It consists of a sluice containing six riffle pans, the riffles being given a motion that prevents packing. A 15-in. machine will handle 15 to 25 cu.yd. per hour, requiring 10 hp. for operation. W. H. Harris, of Imlay, Nev., has devised a pneumatic dry washer, comprising a screen and riffles with a fan to blow air on the latter to aid concentration. Cottrell Engineering Company, of Los Angeles, has produced the "blanket mat" table, consisting of gold-saving corduroy in the form of a power-driven endless belt.

Excavators — Placer mining equipment aside, progress was made in the construction of power shovels for open-pit work and stripping. In the design of machines of this class, alloy steels were increasingly used to give high strength with minimum weight. Anti-friction bearings were used wherever possible, and a simple machinery layout to facilitate repairs. Special attention is given to control features.

The world's largest stripper, rated at 32-cu.yd. dipper capacity and a normal load of 48 tons, went into service in November, 1935. Although on open-pit coal work, it is of general interest. It was built by Marion Steam Shovel Company, equipped by General Electric.

Two excavators for mine and quarry work have been turned out by Marion —one a 2½-yd. close-coupled electric shovel for quarry work and a 4-yd. electric shovel, which is a fast, powerful machine for constant heavy-duty work.

Use of aluminum alloy and high-tensile rolled steel, for parts not subject to the heaviest abrasion, features up-to-date dipper construction, as practiced by American Manganese Steel. Grab buckets have been improved.

Design of Harnischfeger Corporation's Ward Leonard electric excavators has been bettered, principally in increasing the digging speed by better distrubution of weight. Speed is further increased on its Model 400 4-yd. machine by using two swing units.

Drills—Lighter weight, faster drilling speed combined with strong construction, and, so far as drifters are concerned, less demand for constant attention on the part of the runner, were the objectives of rock-drill designers. In 1933, Ingersoll-Rand introduced its fully automatic feed for drifters, a device that frees the driller, increases footage, and requires no power, deriving its action from the natural tendency of a running drill to creep when the feed screw is allowed to turn in only one direction, this being made effective through a ratchet mechanism. The same maker also produced a 99-lb. stoping hammer drill, in which high speed is attained through a flapper valve. Gardner-Denver developed a vibrationless self-feeding drifter, with self-con-

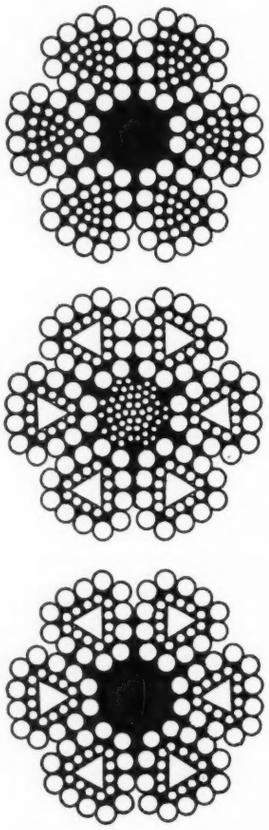
trolled positive action; a 126-lb. drifter and sinker; and a 28-lb. sinker for soft and medium-hard rock and in general for use where weight would handicap. Sullivan brought out a 55-lb. hammer drill, economical of air and flush-lubricated, suiting it for use under dusty conditions. Chicago-Pneumatic developed an 80- to 83-lb. drill for sinking in hard ground; also a 28- to 32-lb. sinker for wet or dry work.

Machines for long-hole work in quarries and for prospecting were conspicuous. Sullivan announced its crawler-mounted 5-ton Stripborer, powered with gas engine or electric motor and capable of drilling 6-in. holes 100 ft. deep. Worthington introduced its Rock Master mobile rig for down-hole, line, and hillside drilling, breast, side, and snake holes up to 20 ft., and the Cleveland Rock Drill Company produced a wagon drill equipped with its D12 drifter and able to drill to any depth possible with drill steel and in any direction around a full circle and at any angle to the horizontal. Keystone Driller Company, of Beaver Falls, Pa., built an all-steel, fully crawler-mounted, completely chain-driven percussion drill capable of putting down 900 ft. of 6-in. hole.

Core drills introduced included a machine of extra light weight, for prospectors, achieved by using magnesium alloys in nearly all stationary parts and eliminating unnecessary metal. It weighs 79 lb., has gas-engine, air, or electric drive, and is good for 250 ft. of $\frac{7}{8}$-in. core. It has no hoist. It was developed by E. J. Longyear Company. The Sullivan Machinery Company built a complete new line of lighter, more compact core drills for underground and surface work, that may be knocked down for air or other transport. A feature of this field, as reported by E. J. Longyear, was the replacement of steam-driven drills by gasoline-powered equipment, particularly in Canada.

Detachable drill bits gained a better footing. Their number was increased by the Jackbit brought out in four types by Ingersoll-Rand. Improved air hose was developed by Manhattan Rubber and by the United States Rubber Company. B. F. Goodrich Company introduced a hose joint (the Flexseal) dependent on a patented end built into the hose. Drill-dust collectors received attention, Spencer Turbine Company producing a unit consisting of a stationary or portable vacuum producer and dust separator with hose and hood for collecting dust at the hole. J. H. Markley invented dust-collecting apparatus, now being exploited by Roots-Connersville Blower Company. It includes an improved hood, a gas-engine-operated suction blower, and dust-separating devices. Pan-American Engineering Corporation developed the Schiffner machine for cleaning plugged steel.

Compressors—Numerous compressors of relatively small capacities and including several of portable type appeared, some for use in severe climates and at high altitudes. Air cooling was prominently used. Of principal interest were the following: A three-cylinder two-stage portable turned out by Ingersoll-Rand in four sizes ranging from 125 to 370 cu.ft. per minute. Two low-pressure cylinders are arranged in a V with the third high-pressure cylinder placed vertically between. Air cooling is used. Also an I-R two-stage, air-cooled, gasoline-engine-driven portable unit which is economical in fuel. Atlas Diesel Company, Ltd., brought out a



WIRE ROPE in cross-section. Three Leschen hoisting ropes of flattened strand construction. Bottom and middle, ropes with hemp and woven centers respectively and a triangular wire in center of each individual strand. Top, a more flexible construction, attained by using hemp in the center of the rope and a woven triangular center in each strand. See text

diesel-driven two-stage portable machine, which will start at minus 30 deg. F. Gardner-Denver introduced a six-cylinder, two-stage, water-cooled vertical compressor, having four small-diameter low-pressure cylinders instead of two large ones, this permitting use of small, light pistons and small inertia loads. This also gives lower air temperatures. The same company brought out a line of three-cylinder machines having two small low-pressure cylinders instead of one large cylinder. Capacities range from 113 to 194 cu.ft. Chicago-Pneumatic also introduced a line of air-cooled compressors with cylinders arranged vertically in line. Sullivan designed a "Micro-Lift" valve for its two-stage, air-cooled, V-type portable and stationary compressors, affording compactness.

Loading Machines — Use of the Eimco-Finlay loader increased. It was introduced in a new large-capacity model (No. 20) for large headings. This operates on track gages of 24 to 42 in. and can be furnished for loading cars 66 in. high above the rails and of standard car length.

Stripping and Open-Pit Transport—In developing equipment for these purposes, the objectives have been lighter weight, higher speed, and ability to negotiate steeper grades. The last facilitates building a dump and permits better use of the dumping area; likewise, it has advantages in open pits, affording faster work with less ore being left under track benches. Working toward similar objectives, the Differential Steel Car Company, Findlay, Ohio, manufacturers of the Differential train, has sought to reduce dead weight of equipment and train length, placing a large part of the payload on the locomotive, a greater part of the train weight on remote-controlled driving wheels, and supplying power necessary for greater speed, so that less equipment is needed.

An electrical three-way-dump larry car, known as the Lococar, was built by Easton Car & Construction Company in 1933. It is trolley operated and has two Westinghouse 50-hp. mine-type motors. The motors use a gear reduction of 13.82. Control is effected by a magnetic, time-current, series-parallel controller of Electric Controller & Manufacturing Company. The car is built in 10-cu.yd. and other capacities.

Standard-gage bottom-dump railroad cars of a capacity, heaped, equivalent to 50 to 55 tons of coal were built by Koppel Industrial Car & Equipment Company for use where speed in unloading is necessary. These cars are built to dump without stopping, the longitudinal split-type doors being automatically tripped open, the load discharged, and the doors then tripped closed automatically. The tripping devices are placed alongside of the track. Sanford-Day Iron Works developed a thoroughly sealed foolproof ball-bearing wheel for mine cars, so designed that the bearing assembly remains undisturbed on the axle when the wheel is removed.

Motor trucks are reported to have made a favorable showing with respect to unit costs in stripping work. The Easton company has built bodies for such work, the largest holding 12 cu.yd. heaped. What is said to be the first automatic bottom-dumping trailer, in which the doors are tripped open automatically, reclosed, and relatched automatically without power other than simply moving the trailer along the road, was developed by Sanford-Day.

This company is also building an air-controlled bottom-dumping trailer. Austin-Western Road Machinery Company introduced some 8- to 25-ton trailer cars with bottom- or side-dump doors.

Locomotives—Developments included the re-design of Mancha's Little Trammer to give the operator more space and better protection against collisions, to make parts more accessible, and to make wearing surfaces larger. Atlas Car & Manufacturing Company redesigned the journal boxes and inclosed drives of its storage-battery locomotives to give additional protection against gritty water, using for this purpose a rawhide seal at some distance from the shielded ball bearing, the space between being filled with hard, fibrous grease. On inserting new lubricant with a gun, the grease is forced outward past the seal, taking the dirt with it. Ruth Company, Denver, brought out for mine use a 40-hp. diesel locomotive with a 2,000-lb. drawbar pull and a speed of 1 to 12 m.p.h. A battery separator material of vulcanized rubber of distinctive internal structure that is unaffected by heat, electrolyte, and vibration was developed by Electric Storage Battery Company.

Locomotives of varying types and sizes for surface and plant service were introduced, among them a 12-ton diesel-powered unit each by Whitcomb and by the Plymouth Works of the Fate-Root-Heath Company; a series of diesel- or gasoline-engine-driven geared locomotives, ranging from 2½ to 25 tons, by Davenport; and a geared 51½-ton fireless locomotive, for steam pressures of 100 lb. or more, by H. K. Porter.

Hoisting—The two Nordberg hoists installed at the Ross shaft of the Homestake Mining Company, South Dakota, are perhaps the outstanding installation made in North America in recent years. One is for ore and the other for men and materials, each having two cylindro-conical drums 12 ft. to 25 ft. and placed in an unusual tandem arrangement. The trend today is toward hoisting from greater depths and winding in a single layer to overcome excessive rope wear, which otherwise occurs. This was the reason for arranging these drums thus; furthermore, placing them on a single shaft as usual would have caused an abnormal fleet angle. The parallel drum shafts are tied together with a train of herringbone gears. For both hoists, the component driving parts are duplicates and interchangeable. The ore hoist has two d.c. induction 1,500-hp. motors and the man hoist one motor. With the various parts common to both hoists, the problem of carrying spares was simplified; and the duplication of parts proved a saving in first cost. This drive arrangement also permitted use of smaller high-speed motors costing less than those of slower speed.

The generator voltage control system is employed to equalize fluctuating loads, and also for safety and reliability. Induction motors of the wound-rotor type are used for securing variation in speed required for effective utilization of the flywheels. Peak loads run to 5,000 hp., but the flywheels limit the demand on power supply to 1,700 hp.

A. Leschen & Sons Rope Company adopted the "preformed" type of construction for its "Flattened Strand" wire rope, previously made only in lang-lay, which tends to untwist and kink. It also developed a more flexible type of flattened-strand rope, produced by using a woven triangular center in each strand instead of one triangular steel wire.

Skips and Cages—Increased use has been made of new alloys, such as Duralumin, Man-Ten steel, and others, in fabricating skips and cages, to lighten their weight. Thus, increased capacity or hoisting depth or both may be obtained with the same hoist. Allis-Chalmers and some other manufacturers are following this practice.

Lighting — The Edison electric cap lamp has been gaining in favor with miners and mining companies somewhat more rapidly in the last two years than before, according to Mine Safety Appliances Company, this being ascribed to the fact that it is better to work with and gives greater and more effectively distributed light, without interruption. Some of the largest companies in the United States, Canada, and Mexico have adopted this type of lamp.

Air Conditioning — An outstanding installation was that supplied by Carrier Engineering Corporation for the Robinson Deep gold mine, on the Rand. It comprised three 50-ton refrigerators, each holding a ton of chemical refrigerant and powered by a 750-hp. electric motor. East Rand Proprietary also decided to cool its air, by washing, cooling, and dehumidifying it with equipment supplied by York Ice Machinery Company, York, Pa. Refrigerating equipment consists of two York heavy-duty, four-cycle Freon compressors, each driven by a 250-hp. motor and producing 300 tons of refrigerating effect with dichloro-difluoro-methane as refrigerant.

Pumps—Efforts to improve pump design have been in the direction of reducing power consumption to a minimum; to protect runners and linings against wear or to make them of effective abrasion-resisting materials; to keep dimensions down; and to produce pumps that will best serve specific purposes. Allen-Sherman-Hoff Company, of Philadelphia, developed its Hydroseal sand pump, wherein the design provides for a flow of clear water or cyanide solution into the volute, which prevents a counterflow of abrasive material through these clearances between impeller and side plates. In this manner, the initial high efficiency stays constant without adjustments or overpumping. Impeller, shell liner, and side-plate liners are, moreover, made of Maximix molded long-lasting rubber.

A centrifugal pump for abrasives which develops good efficiency and costs little to maintain was introduced by Kimball Krogh Division of Victor Equipment Company, of San Francisco. Wearing parts are accessible, thanks to the casing end plate being hinged. Roots-Connersville-Wilbraham produced a line of centrifugal pumps having an open impeller in which end thrust has been eliminated. A single-stage end-suction centrifugal pump without a stuffing box was introduced by A. R. Wilfley Sons for use with corrosive liquids. It has no rubbing contact while running, and leakage is said to be zero. M. R. Hull, of Anaconda, Mont., designed a diaphragm pump without a stuffing box and having two diaphragms instead of one, for abrasives and corrosive liquids. This has increased capacity per unit of floor space and has all parts accessible. Morris Machine Works, of Baldwinsville, N. Y., produced a heavy-duty dredging pump, with wearing parts of special alloys. Casing and impeller are of large diameter, so that the pump will run at comparatively low speeds even against high heads. A high-pressure centrifugal pump of 10- to 250-g.p.m. capacity has been introduced by Byron Jackson Company; also the "Pneumatic Sponge," a centrifugal sump pump operated by a small rotary air motor and designed for pumping about 75 g.p.m. against 125 ft. head. The Gardner-Denver Company has produced a centrifugal side-suction unit, with a capacity that ranges up from 450 g.p.m. at 100 ft. lift.

Conveying—Both underground mining and surface work have seen interesting advance in the application of belt conveyors. A Quebec gold mine has a unit 130 ft. long on its 1,200 level for transferring ore from crusher to pocket and a 525-ft. conveyor running from the first level to the surface crushing plant. A novelty in the Iron Country is the Mesabi Chief's stacker, comprising three Link-Belt conveyors, for storing iron-ore concentrates when shipments are interrupted. And, most important in its promise for open-pit work in the future, is the large-scale application in 1935 of belt conveyors, engineered by Jeffrey Manufacturing Company, to the work of excavating for the abutments of Grand Coulee dam, in the Pacific Northwest—a 2-mile network of 60-in. conveyors transporting overburden from the diggings and lifting it over 500 ft. to a dump a mile distant at an average rate of 40,000 bank-yards per 21-hour day. Belt delays accounted for only 5 per cent of lost time.

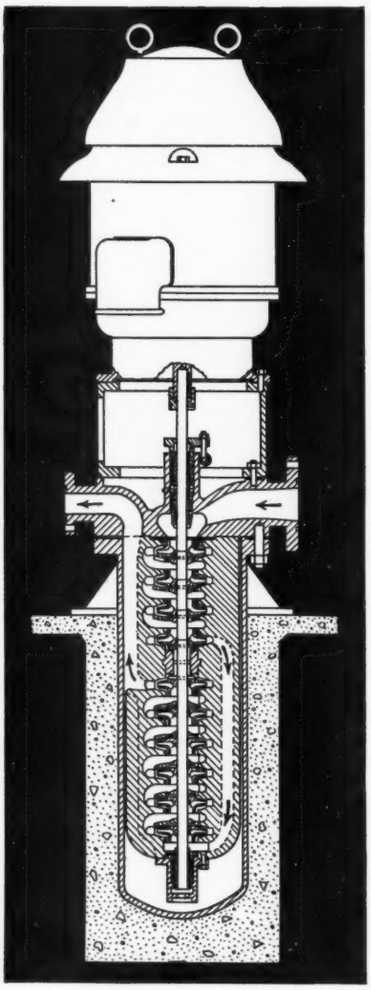
Use of roller bearings in both troughing and return idlers has become universal, thanks to the development of improved dust and grease seals and to other means of prolonging bearing life. Straight running of belts has been made automatic through the development of belt-aligning idlers, such as those made by Robins Conveying Belt Company and Stephens-Adamson Manufacturing Company, for both the top and bottom

strands. Use of roller bearings for head and tail terminals, take-ups, is more general; also the use of the automatic take-ups. For heavy-duty tripper conveyors, a more general tendency is to use motor drives or rope hauls in place of propulsion by the belt. When handling ore containing large lumps, protection of belt and idlers at loading points has been secured by the development of extra-heavy troughing idlers on which the pulleys are protected by thick rubber covers.

Among conveyors of other types, it is to be noted that Stephens-Adamson has redesigned the flights on its Redler conveyor, and Kennedy-Van Saun has developed a pneumatic system for transporting cement, pulverized coal, phosphate, and other fine materials. A hot-material belt of long flexing life and made for use in atmospheric temperatures up to 300 deg. F. and to carry material up to 250 deg. F., and to this end provided with a cover more resistant to abrasion than regular grades even after prolonged exposure to heat, was turned out by B. F. Goodrich Company. The cover is also acid-resistant and low in water absorption. This company also developed the Plylock splice for making rubber belts permanently endless.

Akin to conveyors are pan feeders. In one of these, developed by Robins Conveying Belt Company, the pans are of manganese steel, strongly built and so overlapped and interlocked, especially at the sides, that no spill occurs and all deflection or sagging is avoided. They have links and pins of unique design. Denver Equipment turned out a self-contained belt feeder of all-steel construction and adjustable speed, and the Hardinge Company introduced its Constant Weight feeder, which feeds by weight instead of volume. A constantly weighing feeder was turned out by Jeffrey Manufacturing Company, also a vibrating pan feeder having a grizzly in one of the pans.

Crushing — Some new crushers of unique design appeared. Taken in order of announcement, the Smith Engineering Works, Milwaukee, presented the Gyrasphere, a secondary breaker wherein a spherical head, fixed on an alloy-steel shaft, and a concave ring, constituting the crushing members, develop a unique crushing action, the spherical form of the head causing the greater part of the crushing to be accomplished by an upward and not a sidewise thrust. Pennsylvania Crusher Company, Philadelphia, turned out a primary jaw breaker having a four-part cast-steel frame, special attention being given to proper distribution of load, and a toggle system of unusual character. Thanks to the pitman design, only one member is needed as a central bearing for both toggles. These have three times the usual bearing area, reducing the unit pressures. Next, the Eimco Corporation brought out the Eimco-Fahrenwald jaw crusher, a long-stroke



VERTICAL MULTI-STAGE PUMP of the Hydropress type made by Byron Jackson Company. It gives a continuous non-pulsating flow at lifts ranging up to 10,000 ft. and pressures up to 2,800 lb. It is directly connected with driving motor or turbine without the use of gears. It is intended for mine unwatering and other service

machine, with toggles omitted to permit successful operation. Design and suspension of swing jaw and method of operation are novel. There are two models, one with a single jaw, for coarse or fine reduction crushing, and a double-jaw machine for intermediate and fine reduction.

Meanwhile, the Hardinge-Hadsel mill was being redesigned to overcome defects obvious to the builder. As announced in June, 1935, the new mill now has the drum suspended in a cradle on wheels with roller bearings. Outside the mill entirely is the classifier, which receives as its feed the undersize from a grizzly positioned ahead of the first breaker plate, the oversize remaining in the mill. Several of the new models are in service. Increasing use was made of the Symons Short Head cone crusher, in particular it being employed in various places in closed circuit with the standard Symons cone crusher, previously installed, after opening up the latter to produce a coarser size. Stamps appear to be losing further ground to ball and rod mills.

Innovations in grinding machinery were scarce. Mine & Smelter Supply Company built a 42x60-in. ball mill for small plants. It can be entered for relining without dismantling it. Hardinge Company developed a unit coal pulverizer which keeps the load constant at all settings. A so-called "Bowl" mill for coal pulverizing and firing, and for reducing non-metallic minerals, was introduced by Raymond Bros. Impact Pulverizer Company. It comprises two reduction rolls revolving without metal contact in a bowl or grinding chamber that turns smoothly on a vertical axis. Centrifugal force causes the material being ground to work up the inclined sides, where at the top the finer sizes are caught by an air current and taken into a separator above for classification. Capacity is 1 ton per hour and up. Kennedy-Van Saun developed a 200-ton milling plant comprising a disk feeder, a ball-bearing gearless crusher, and a gearless tube mill with a duplex classifier. For pulverizing cement clinker the Traylor Collins pulverizing mill was built.

Ore Washing—Allis-Chalmers introduced the "Blade" mill, a drum having log-washer type teeth arranged around the inside surface, which is intended for washing ores containing clay and slimes. It is said to have wider application than the standard log washer. It can handle material up to 12-in. size.

Screening — This field has seen a great development in the use of the so-called circle-throw or positively vibrated screen, an outstanding example being the Robins Gyrex, now employed for both coarse and fine screenings, such as for scalping ahead of small primary crushers or, following large units, for scalping in front of the secondary, separations being made at 4- to 8-in. openings in the first case and down to a ¼-in. opening in closed-circuit work in fine-crushing plants. Development of screening surfaces able to stand punishment and of non-blinding surfaces for sticky material has facilitated this expansion. Ludlow-Saylor have utilized an improved alloy for heavy-duty woven-wire screens, yielding a hard, tough, resilient wire.

A flat-lying screen (the Symons), so vibrated as to give a conveying as well as a screening effect and made in various sizes, was put out by Nordberg. It effects quicker stratification and removal of undersize. A horizontal heavy-duty screen for wet or dry work (the Telsmith Pulsator) was introduced by Smith Engineering Works. The Deister Concentrator Company improved its Leahy screen by using heat-treated tool steel for wearing parts.

A bar screen having 1- to 3-in. openings and with the bars fixed at one end only (cantilever type) was brought out by Allis-Chalmers. Impact causes the

free ends to vibrate, and stops clogging.

Noteworthy is the process, introduced in 1935, of Electrolytic Products Corporation, New York, for making smooth surface screens of any metal that can be deposited electrolytically. The mesh can be as fine as 400 holes per inch.

Classifiers, Thickeners—Trend of design has been toward greater rigidity and refinement, and also toward reduction of headroom to a minimum. In thickeners, the latest development of the Dorr Company is the "Centrepier" type devised for continuous thickening and clarification and having self-lifting and lowering rake arms for compensating automatically for overloads. Rakes rise and fall, according to the load, altering the slope of the bottom and the required torque accordingly. Rake, motor drive, and inboard end walkway and feed launder are supported by a stationary center pier, avoiding a cumbersome superstructure. This thickener is available in all sizes. The Hardinge Company introduced its Center Post thickener. In the Dorr Type A thickener and the Type A agitator the old bridge-type superstructure is replaced by a short-compact drive head carried by two beams. The lower end of the vertical shaft is held in alignment by a submerged steady bearing. Denver Equipment Company likewise turned out a beam-type thickener.

Announced in October, 1935, the Dorr turret bowl classifier embodies the old Dorr bowl classifier principle but has an improved drive. This is a turret-like unit, filled with oil and carried on two beams. Construction is stiffened and the rakes are improved.

Other classifiers introduced are: General Engineering Company's Geco double-acting machine, which, by using two sets of reciprocating rakes in the same tank, largely eliminate surging and approaches continuous delivery of oversize; Colorado Iron Work's new duplex submerged-spiral-type of Akins classifier, which avoids agitation near the overflow weir and is intended to give large overflow capacities or extremely fine overflows or high densities; the Straub Manufacturing Company's Rib-Cone screen-wheel classifier; Kennedy-Van Saun's washing classifier and dewaterer; and Deister Concentrator Company's Concenco constriction-plate classifier for classifying table feeds.

Concentration—Following the earlier introduction of the Denver unit flotation cell in grinding-mill circuits to remove coarse gold as soon as possible, Denver Equipment Company in 1935 brought out the two-compartment Denver mineral jig for similar application. It can also be used for removing copper, lead, zinc, tungsten, and manganese minerals. Design has been adapted to the need of dilution control and handling an unsized feed. The two plungers are sealed with rubber diaphragms to give positive displacement of water, and dilution is added only on one part of the stroke of the plungers to counteract the suction normally created. The water action resulting approximates the perfect theoretic jigging action. The company also turned out its Sub A flotation machine in three small sizes (22x27 in. to 28x44 in.), each in any number of cells, this for small mills; also a small disk-and-bucket type reagent feeder for use with unit cells. Pan-American Engineering Corporation brought out a smaller model of its Kraut flotation cell, for handling 10 to 20 tons per day. The Galigher Company also developed an all-steel Agitair flotation machine, General Engineering Company its Geco machine, and Morse Bros. Machinery & Supply Company the Weinig machine. The Mine & Smelter Supply Company pushed the Clark-Todd amalgamator, recommending it for use in grinding circuits between mill and classifier.

In tabling, Deister - Overstrom diagonal-deck tables have been used successfully for cleaning refuse from sand and gravel. The manufacturer (Deister Concentrator Company) forecasts the greater use of tables as scavengers in grinding-mill circuits (in place of unit flotation cells or jigs) and holds that, in most flowsheets, tables can be used profitably with flotation.

Among developments in magnetic concentration, the Magnetic Manufacturing Company brought out a high-duty separator, of the inverted-drum type and having a unique magnetic take-off and requiring only one handling of material. Dings Magnetic Separator Company developed an air-cooled magnetic pulley having an attraction and range 25 per cent greater than previously obtained.

Filtering—New products include the Caloco horizontal filter, made by Canadian Locomotive Company, Kingston, Ont. This consists of a series of stationary vacuum boxes over which is carried an endless suction belt or mat, on which, in turn, rests an endless strip of filter cloth which receives the pulp to be filtered. At the dry end, the cloth leaves the mat, discharges the cake, and returns to the beginning. A batch-type vacuum-pan filter (the Bee-Tee) was developed by the Galigher Company's Booth Thompson Division in three sizes capable of filtering 1 to 8 tons of flotation concentrates in 8 hours.

Oliver-United brought out a low-submergence continuous filter, so designed that only a small portion of its drum is submerged in the pulp, the main part being given over to aërating and washing (for cyanide slimes) or to dewatering (for concentrates). This filter operates at considerably higher speed than the standard Oliver but carries a thinner cake. Its capacity normally is higher. Because of its longer aëration and washing, more gold is made soluble and recovered. Concentrates may be discharged with a lower moisture content. Discharge is "inverted"; that is, the cake falls away from the cloth by force of gravity and is discharged without anything touching the cloth. For small-tonnage mills or for test and pilot use this company also produced a small, continuous-filtering plant comprising a 3x2- or 3x4-ft. Oliver filter, vacuum pump, receiver, tank, and motors. Total weight is about 30 per cent less than that of the standard unit with accessories.

Furnaces — The past year saw the proving of a new and simplified method of charging reverberatory furnaces to overcome operating difficulties and lessen expense. At a Western copper smelter two furnaces have been thus modernized by installing electric vibrating conveyors of the Jeffrey-Traylor type furnished by the Jeffrey Manufacturing Company, of Columbus, Ohio. Each furnace is served by two of these conveyors, which are of the cantilever type, 18 in. wide and 80 ft. long, and installed above and along the furnace. The conveyors are each equipped with 22 quick-acting discharge gates manually operated in an arrangement that permits spot feeding at any place and any time. This method has eliminated a railroad, storage bins, and much manual labor. Free of mechanical wearing parts, the electric vibrating conveyors are especially fitted for such hot and severe service. They handle corrosive concentrates at lower operating and maintenance cost.

Refractories — Magnesite brick are being widely substituted for silica brick in reverberatory furnaces used in smelting and refining work, according to Dr. R. P. Heuer, director of research of General Refractories Company. Heretofore it has been customary to employ magnesite brick at or below the slag line of such furnaces. The older type of magnesite brick was not suited for construction of furnace roofs and sidewalls above the slag line, due to the tendency of such brick to spall excessively. With the development of the Ritex process for manufacturing magnesite brick, this spalling difficulty was overcome. It is now possible to construct complete magnesite roofs for the largest reverberatories. The original installation of this kind was made at Flin Flon, and the advantages of magnesite over conventional silica roofs have been amply proved there during the last two years. Following the Flin Flon installation, other large magnesite reverberatory roofs have been placed in successful service.

The use of basic roofs as a substitute for silica in copper-refining furnaces is now being tried. Initial runs have been encouraging. It seems reasonable to expect that the ultimate refining furnace will be of basic brick construction for bottom, side walls, and roof, with little or no silica or fireclay brick being used in the important parts of the furnace. When basic brick are used in this way the insulation of furnace sidewalls seems to warrant the expense involved. Basic brick are refractory enough to withstand the more severe working conditions occasioned by the use of insulation.

NEWS
OF THE INDUSTRY

Deeper Gold Dredging Planned For Bulolo Fields, in New Guinea

Two Dredges Will Recover Substantial Yardage of Gravel Beneath the False Bottom on the Original Area—Mount Morgan, Ltd., to Increase Milling Capacity and Will Erect a Cyanide Plant—New Tin Company Formed

BULOLO GOLD Dredging is to install two deep digging dredges to handle the wash lying below the false bottom at 25 ft. on the first Bulolo area, New Guinea. There is 80,000,000 cu.yd. of deep gravel, valued at 38c. (Canadian) with gold at $35 (Canadian). One dredge will dig to 120 ft. (80 ft. below water level) and the other to 165 ft. (115 ft. below water level). For the year ended May 31, 1935, the company's four dredges dug 9,920,700 cu.yd. for a recovery of 127,901 fine ounces of gold and 56,653 fine ounces of silver. The yield was 6.2 grains of fine gold per cubic yard. The total gold recovered to May 31, 1935, is 289,884 fine ounces of gold from 21,705,600 cu.yd. Dredging costs for the last financial year were 10.87c. per cubic yard.

✦ Mount Morgan, Ltd., operating the famous gold-copper mine in North Queensland, is planning to increase its flotation plant to treat 40,000 tons monthly, instead of 25,000 tons, as at present. The first increase will be to 30,000 tons monthly. A new cyanide plant is to be built at a cost of £76,000 to treat 400 tons of oxidized ore daily; this will be extended later to treat 800 tons daily. At least 1,500,000 tons of oxidized ore assaying 2.7 dwt. is available. The power plant is to be remodeled at a cost of £50,000. The company has in mind the re-treatment of several huge dumps of tailings, and a method of treatment is being evolved. Mount Morgan will eventually become Australia's premier gold mine.

✦ Gold Mines of Australia, Ltd., in conjunction with Gold Exploration & Finance Company, Ltd., is expected to float a new company to carry out dredging operations at Newstead, Victoria. Two modern dredges may be installed. One section has been proved by boring to contain more than 20,000,000 cu.yd. averaging 3.3 grains gold per cubic yard. Gold Mines of Australia is also interested in several deep lead properties in Victoria.

✦ Zarda Alluvial Tin, Ltd., has been formed with a capital of £50,000 in 2s. shares to dredge an area on the Mossman River, North Queensland, which is estimated to contain 8,000,000 cu.yd. averaging 5-lb. tin oxide per cubic yard.

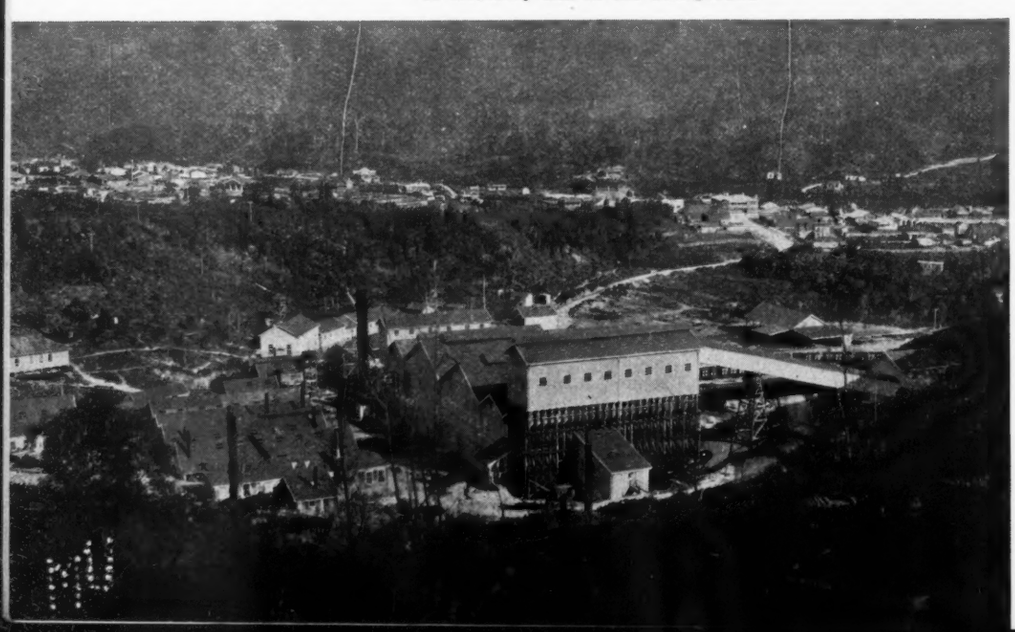
✦ Not fewer than 235 properties were submitted to Gold Mines of Australia, Ltd., for examination during the period from August, 1934, to November, 1935. On the data submitted 190 were rejected without examination and 37 after examination. Only eight of the properties warranted further testing. This indicates that good gold mines are becoming increasingly scarce.

✦ Norseman Gold Mines, N.L., Norseman, W.A., which is milling 5,000 tons monthly, has ore reserves of 157,000 tons assaying 9.6 dwt. This mine is near that of the Central Norseman Corporation, upon which a treatment plant with a capacity of 3,000 tons monthly is being erected. This will be enlarged later.

✦ Carshalton (B.M.L.) Mines, N.L., one of the three subsidiary companies of Bendigo Mines, Ltd., operating at Bendigo, has met a wide payable spur formation on the 300-ft. level. The formation is carrying fine gold over a length of 120 ft. and up to a width of 10 ft. This is the first payable formation met by any of the subsidiaries of Bendigo Mines, Ltd., and proves that the faith of the company in the Bendigo field is justified. A number of other mines at Bendigo are meeting with favorable developments.

✦ Cuthberts Misima Gold Mine, Ltd., has been formed to develop and equip the new Misima mine, on Misima Island. The ore reserves are estimated at 81,340 tons assaying 55s. Australian currency. Adjoining this property on the north is that of Gold Mines of Papua. Recent development work from adits has proved 400,000 tons on this property. A cyanide treatment plant with a capacity of 6,000 tons monthly is to be erected.

Rosebery mill of the Electrolytic Zinc Company or Australasia, Ltd., in Tasmania, which came into operation in January, 1936. The mill has a capacity of 3,500 tons of lead-zinc ore weekly and was completed in 1930. Low metal prices, however, prevented operations at that time. The ore assays 7 per cent lead, 21 per cent zinc, and 8 oz. silver per ton. The main office is on the left center, with workshops and assay office in left foreground. The mill with conveyor housing from the ore-crushing plant is on center right. The town of Rosebery lies in the background



(Continued from page 84)

Russia's Mineral Industry Set for Faster Growth

in the Kara-Tau Mountains, about 42 miles northwest of Turkestan. These orebodies are replacement deposits in Devonian and Carboniferous limestone consisting of ocherous clay with cerussite, averaging about 15 per cent lead. A recently constructed railroad hauls concentrate from the 650-ton mill at these mines to Chimkent via Turkestan.

The largest lead deposits are those in the Ridder district, which lies in the western part of the Altai Mountains. Construction of additional power, milling, and smelting facilities now being made at Ridder will add materially to the lead production during the next two years.

Numerous lead deposits in the Far East are being developed, but most of the production in these parts comes from the Tetiuhe mines, north of Vladivostok, in the Maritime Province.

Domestic production does not meet requirements, and an adequate supply may not be reached for some time. Until then lead imports will probably continue. During eleven months of 1935 Russia imported 25,156 tons of lead, against 18,729 for the year 1934.[2]

Russian zinc production has given a better account of itself during the last four years. The 1935 planned production was completed on Dec. 23, when 53,805 long tons were produced. This compares with 27,055 tons in 1934. Production for 1936 is set at 75,000 tons. The copper program was also fulfilled in 1935 and about 75,000 long tons produced. Imports of zinc decerase during 1935, from 4,317 tons in 1934 to 1,474 tons (11 months) in 1935.

Nickel deposits have been found in the Ural, Kola Peninsula, and at Noril, Northern Siberia. Some nickel is produced, but the mines are only in the development stages. Tin is mined in small quantities in the Transbaikal region. These metals are on the import list, and purchases increased in 1935 above the imports for 1934.

Russia's mining industry has been plodding ahead since 1927 and has acquired practical experience in the school of hard knocks. Technical knowledge has been absorbed, and with greater investments in machinery and knowledge of its proper use, results obviously improve. The part of the new Stankanov movement in the mining industry may be described as a Russian miner who has thrown away his single jack and is eager to use pneumatic rock drills. Many have educated themselves in the proper mining technique that breaks ore above their old averages, all of which contributes to greater production.

[2]Statistical Survey of Foreign Trade, U.S.S.R.

Mexico's State of Guerrero Expects Greater Mining Activity in 1936

Companies Operating in Southern State Disclose Increased Ore Reserve Possibilities Resulting From Recent Development—Attempts Are Being Made to Settle Strike at Cananea Consolidated Copper Mines

SOME NEW enterprises, but the same old labor troubles, were high lights of the Mexican mining industry this midwinter. Shipments of metals such as lead and zinc were made to several European countries, principally Germany, France, and Belgium, and to Japan. Guerrero State showed considerable activity early in the year, as two new companies began operations.

✦ Strike threats made by 9,000 unionized miners employed in the Pachuca and Real del Monte zones, in Hidalgo, by Real del Monte y Pachuca, Dos Carlos, Santa Gertrudis, and San Rafael, were withdrawn when the companies agreed to allow them one day a week off, with pay on the following basis: After six consecutive days, 100 per cent; five days, 90 per cent, and from two to four days, 50 per cent.

✦ Cia. Minera Berilo, Oro y Plata de Mexico, S. A., holding organization of which is Beryl Gold & Silver Corporation of Mexico, Inc., with headquarters at 16 de Septiembre and Bolivar, 34, Mexico, D. F., announces that engineers who investigated its new Ethiopia mine, at Cerro del Amate, near Taxco, Guerrero, estimate the property to contain 99,000 metric tons of ore, which is expected to yield four grams of gold, one kilogram of silver, and 27 per cent lead per ton. The mine is working three shifts daily and the company is surveying the route for a road from the property to Kilometer 171 on the Mexico, D.F.-Acapulco highway. M. T. Zapata is general manager for the company.

✦ Companies operating in the Temixco y Achotla, Xintinga, Montecarlo, Tetipac and Atlixtac zones, in the State of Guerrero, where work has been conducted on a moderate scale, plan intensified activities this winter, as high-grade ore has been found.

✦ Conversations are being held under the direction of the federal labor department between representatives of Cananea Consolidated Copper, operating at Cananea, Sonora, to settle a strike that started on Jan. 2. Strikers assert that the company refused to make new collective labor contracts with them which would allow higher wages. The company recently made a liberal wage adjustment to the workers.

✦ Operation of the Los Cuates mine, near Los Cuates, Sinaloa, which was a great silver producer from 1900 to 1903, is to be undertaken by the Neg. Minera Los Cuates, headquarters of which are at Justo Sierra, 7, office 206, Mexico, D. F. William A. Burr, an old mining man of the Parral region, Chihuahua, is manager.

✦ Daily production of Compagnie du Boleo, a French enterprise operating at Santa Rosalia, Lower California, is now 700 tons per day of silver-copper ore mined and smelted. Mining and smelting staff comprises more than 1,000 men. Officers of the company at the workings are: August Nopper, manager; Jules Bellebouche, mine superintendent; Albert Ferraris, chief mine engineer; Joseph Geoffrey, smelter superintendent; Victor Mussio and Jean Siffre, general superintendents; Roger Delbaut, purchasing agent, and Juan Echeverria, construction engineer.

✦ A 50-ton flotation plant is being built by Neg. Minera de Los Reyes, S. A., on its property in the Guadalupe de los Reyes region, near Mazatlan, Sinaloa. Ernesto Lorda, Apartado Postal 80, Mazatlan, is president and general manager of the company.

✦ Unionized miners of the Charcas region, San Luis Potosi, have organized a cooperative society, known as "Mineros de Charcas," with the aid of the ministry of national economy to work properties abandoned by companies because of unprofitable exploitation due to low-grade ore.

✦ Preliminary work is being done for operation of tin and antimony mines in El Centro, Pinal de Amoles, and Toliman municipalities, Queretaro, the minstry of national economy announces. Gold and silver deposits are also to be worked in El Centro municipality.

✦ A federal health department commission of mining engineers and physicians has started in the Pachuca zone, Hidalgo, a national inspection of mines to ascertain whether or not the properties are equipped with proper sanitary and hygienic facilities for men working underground.

✦ The San Francisco Mines of Mexico, Ltd., has established a school for the children of its workers at San Francisco del Oro, Chihuahua.

✦ President Cardenas announces that federal mineral reserves were increased in 1935 by the addition of 109 lots with a total area of 22,233 hectares.

Brisk Development of Chibougamau-Opemiska Area, in Canada, Continues

Several Large Companies Interested in the Merits of This Area Proceed With Prospecting and Diamond Drilling—Stockholders of Granby Consolidated Vote to Dissolve Company—Chromium Mining Adds Two Furnaces

THE LARGER Canadian mining companies are not now, as formerly, deterred from developing prospects at a great distance from a railway. This is well exemplified in the Chibougamau-Opemiska area, where the distances from the track are 140 to 175 miles. Consolidated Mining & Smelting continues vigorously its underground operations at Chibougamau on substantial copper-gold deposits, but has made no announcement as to results. At Opemiska, 40 miles to the west, Ventures are installing a mining plant brought in over the newly cut winter road from the railway, 140 miles to the southwest. Surface work and diamond drilling during the past two years have disclosed high-grade gold-copper deposits north of the original finds, and these will be the first opened underground. Noranda and Dome, after drilling their properties at Chibougamau, are awaiting developments. A number of smaller companies are developing recent surface finds.

ONTARIO

✦ The success of the Pamour mine, at the east end of the Porcupine camp, has drawn attention to the other properties that may develop into important producers. Central Porcupine, lying in an area which includes Dome, McIntyre, and Coniaurum, is being developed from a long drift from the 1,000-ft. level of Coniaurum. Though no large tonnage of ore has been found as yet, the chances for finding it are still good. Paymaster, lying between Dome and Buffalo-Ankerite, was reopened over a year ago, as a merger of several smaller properties and recently has been milling 300 tons a day from its rather scattered working down to the 1,000-ft. level. There is now some evidence that, in addition to the rather small shoots of ore mined up to the present, there are large deposits of lower grade that might support a much enlarged mill. It is expected that this possibility will be explored thoroughly during the year, and that meantime the present mill will be stepped up to 500 tons. C. E. Cook is manager.

✦ Howey's output for 1935 was $1,321,372 from 484,966 tons, with operating profit of $471,449, which is about two-thirds the operating profit of 1934. The operating cost per ton was $1.76. The Ontario Hydro Electric Commission is installing 5,000 hp. additional at the Ear Falls plant to provide for new mines and the expansion of established plants. Howey and McKenzie Red Lake have signed for additional power, and it is probable that Red Lake Gold Shore, Madsen, and Cole Gold will have mills and require power.

✦ Sale of Marbuan Gold Mines to its neighbor, Buffalo Ankerite Gold Mines, on the basis of one Buffalo Ankerite share for six shares of Marbuan, was indicated by notices mailed shareholders of both companies. Marbuan shareholders were called to a special meeting at the Royal York Hotel, Toronto, at 2 p.m. Jan. 22, to consider, and, if agreeable, to ratify the sale. Engineers point out that problems confronting the mines individually could be better handled under joint cooperation.

✦ Chromium Mining & Smelting Company, with a mine at Obonga Lake, north of Lake Superior, and a ferro-alloy plant at Sault Ste. Marie, is now in regular production, with a capacity of 5 tons of ferro-chrome a day. Two additional furnaces are under construction, and a concentrator is being built at the mine. A. R. Globe is manager.

✦ A number of the old silver properties at Cobalt are now owned and operated by Smith Cobalt Mines, Ltd., and a substantial tonnage of silver and cobalt ore is being recovered. The manager is D. J. Russell.

✦ The Sturgeon River Gold mine of Coniagas Mines has now been opened on four levels down to 500 ft. and shows on these levels a length of 250 to 400 ft. of ore running 1 to 3 oz. across approximately 9 in. The vein is not fully explored laterally as yet. It is expected that a stoping width of 30 in. will be established and that half the rock broken can be sorted out as waste. C. M. Bowyer is manager.

✦ Stadacona Rouyn has commenced the construction of a 200-ton mill, which is expected to be in operation early in the summer. M. D. Kennedy, manager, reports 170,000 tons of ore of $7.96 average grade developed above the 600-ft. level, and a much larger amount indicated. The mine is 4 miles south of Noranda. J. E. Grant is constructing the mill.

✦ Tashota Goldfields is now treating 75 tons daily of $12 to $14 ore, at an operating cost of about $7 a ton. About 60 per cent of the gold is recovered at the mine by amalgamation and 25 per cent in a flotation concentrate, which is being shipped to a smelter.

Crushing Plant of the Ymir Consolidated Gold Mines, Ltd., Ymir, B. C. The capacity and operating arrangement of the plant and tram are such as to permit one-man operation and crush 110 tons ore in an eight-hour shift. The fine product permits relatively lower grinding costs and more uniform classifying.

MANITOBA

✦ An interim report of Central Manitoba Mines covering the four months September to December, 1935, shows a slightly improved position. The recovering was 5,077 oz. worth $178,800 from 14,849 tons. Operating profit was $63,326, bringing the net working capital to $233,750. The reserve at the end of the year was 15,100 tons averaging 0.35 oz. As it has been shown that diamond-drill intersections do not give a reliable indication of values, some sections of the mine where low values in the cores are coupled with favorable geological indications are to be explored,

and the Hope shaft is being deepened for this purpose. J. C. Houston, at Wadhope, is manager.

BRITISH COLUMBIA

✦ The value of mineral production in the Province of British Columbia during 1935 is estimated by the Department of Mines to have been $47,807,000, which is 13 per cent greater than in the previous year. The largest increase was in the output of gold, which was 410,350 oz. in 1935, valued at $14,261,000, as compared with 322,300 oz. in 1934, valued at $10,965,000. Nine new mills for the concentration of gold ores were placed in operation during the year, several others were enlarged, and four more are under construction. The aggregate capacity of plants at gold mines thus was increased by 1,000 tons. It is now indicated that plants having a total capacity of 2,000 tons will be erected in 1936, including a 1,500-ton mill at the Big Missouri mine, in the Portland Canal district. Silver production last year was 8,704,000 oz. as compared with 8,572,916 oz. in 1934.

✦ The Consolidated Mining & Smelting Company, which contributes the bulk of the lead, zinc, and silver produced in the Province, reports that in 1935 its output of the first two of these metals exceeded all previous records. At the company's plants at Trail, 164,329 tons of lead was produced last year, compared with 157,673 tons in 1934; and 119,840 tons of zinc was produced, compared with 110,978 tons.

✦ Stockholders of Granby Consolidated Mining & Smelting & Power Company at a recent meeting approved the plan for voluntary dissolution on the company's affairs. It was voted on Jan. 23 that the Allenby properties, idle since 1930, are not to be sold without permission of the stockholders.

✦ The manager of Hedley Mascot Gold Mines, W. R. Lindsay, operating at Hedley, in the Osoyoos district, states in a progress report that the 3,000-ft. tunnel will have been completed and raises driven into the Nickel Plate orebody by the end of March. It is also expected that the 150-ton mill be ready for operation by then. Ore reserves are estimated to be 230,000 tons, carrying between 0.4 and 0.5 oz. gold per ton.

✦ At the Dentonia, near Greenwood, 2,561 tons of ore was milled in December and 1,268 oz. gold and 9.070 oz. silver produced in concentrate. Net smelter returns were reported by the president, N. B. Smith, to have been $44,800, and the net operating profit was $29,947. A cash surplus of $200,000 has been accumulated.

✦ At a recent general meeting of Ymir Consolidated Gold Mines it was revealed that the 100-ton mill was closed in December because of the lack of commercial ore. It was decided to explore the shear between the Ymir and Goodenough workings, and to operate the mill on a limited basis as ore is developed.

✦ At the Reno, in the Sheep Creek camp, December production was valued at $77,606, bringing the total value of output in 1935 to $755,496. Two more levels are to be opened, Nos. 10 and 11, and the shaft is being sunk an additional 250 ft. for this purpose.

✦ Since the 150-ton plant was placed in operation at the Sheep Creek Gold Mines in May, bullion of a value of $318,122 was produced to the end of 1935. The shaft is being sunk an additional 250 ft. to open levels 9 and 10.

Greater Production Anticipated on The Rand During Current Year

Mining of Low-Grade Ore Will Probably Continue, but Higher Tonnage Expected to Be Treated—Exploration of Eastern and Western Areas Support Assurance That Two New Gold Districts May Be Added to the Region

NOVEMBER'S figures having been announced by the Chamber of Mines, it becomes apparent that the gold mines of the Transvaal made a working profit of about £32,000,000 last year from the treatment of just over 45,000,000 tons of ore. Both tonnage and profits were new high records. The rapidity with which the activities of the Witwatersrand area are expanding is indicated by the total tonnage milled in 1934, which was 39,722,850, so the increase in 1935 was over 13 per cent. There is a good prospect that over 50,000,000 tons will be put through the mills this year. Whether even that will set up a new record of ounces produced is doubtful, as the average grade of the ore beneficiated has been greatly reduced. It was down to 4.611 dwt. per ton in October, but the slight increase, to 4.615 dwt. in November is taken by some to indicate that the tendency to reduce the grade has been arrested for the time being. However, the average will be determined by the activities of the several individual producers, and the treatment of very low-grade ore is certain to increase much more rapidly and largely than of high-grade ores. Working costs have risen somewhat, averaging just over 19s. a ton. As 3 dwt. are worth 21s., and vast tonnages have been made ore by the rise in the price of gold, a continuing decrease in the average grade should be expected.

✦ Interest in operating results is almost overshadowed by that in the exploration of the Far Western and Far Eastern Witwatersrand. A drill found 101 dwt. over a borehole width of 6.5 in. at a depth of 1,972 ft. in Western Rand Estates property. It was deflected later into Venterspost ground and has cut 8.5 in. averaging 87.9 dwt. at a depth of 1,971 ft. This is calculated to be about 400 ft. above the Main Reef itself. Drilling is continuing and has since cut, at 2,402 ft. 23 in. of 4.7 dwt. ore. These and other drilling results both east and west seem to assure the development not merely of new mines but of two great new gold-mining districts.

✦ Gold mining financing and development are not likely to be confined wholly or chiefly to the Rand, however. The leading mining interests in London are conducting extensive exploration work almost everywhere that gold is known to exist, and new properties of considerable apparent merit are being developed in the Tanganyika, Kenya, Gold Coast, and Rhodesia areas in Africa, in Figi, Western Australia, and Western Asia. Several of these are expected to raise the funds within the coming few months for the purchase and installation of plants.

✦ The management of Burma Corporation, Ltd., has been able to make a more cheerful statement to shareholders than the report of a year ago. It then had to be admitted practically that the mine had been bottomed, all efforts to find payable ore at greater depths having failed. Since then workings have been extended laterally with gratifying results, some 347,987 tons of about average grade having been added to reserves, and there is a good prospect that this will be largely increased by further development. Production costs have also been substantially reduced. Ore reserves were calculated as 3,965,574 tons when the year ended. It is planned to sample and measure all the ore remaining in the mine with a view to arriving at a correct estimate of reserves. This will be completed, it is hoped, before the current year's report is written.

✦ St. Swithin's Ores & Metals is the name of a company being formed to work a wolfram deposit in Southern Rhodesia, near the Wankie Colliery. Sir Edmund Davis has had the property under option for a year and is understood to have explored it extensively before purchasing it.

Electrolytic Zinc Plant at Kellogg, Idaho, Operating at Capacity

Reopening of Mines Producing Base Metals Boosts Smelting Activities in Coeur d'Alene Mining Region—Hailey Triumph Mines Company Unwatering Mine and Preparing for Operations—Sunshine Mining Company's Offices Moved

THE ELECTROLYTIC zinc plant owned and operated by the Sullivan company at Kellogg, Idaho, has increased its output to the full capacity of the plant, approximately 70 tons of cathode zinc every 24 hours. Capacity output has been necessary by the operations of the Star mine, at Burke, which is now mining 250 tons daily, the ore being concentrated at the Hercules mill, in Wallace. In addition to ore from the Star mine, the smelter receives concentrates from the Sidney, on Pine Creek, operating at a daily rate of 100 tons. Concentrates from the Bunker Hill & Sullivan mills also contribute to keep the plant operating at capacity. The smelter is equipped with five 270-ton capacity reinforced-concrete bins which receive the concentrates from the cars. At the normal rate of feed this is a ten-day supply for the roasters.

✦ The Shamrock mine, in the Hayden Lake district, will be active during the winter, according to officials of the company. The property is located on Hayden Creek and has been under exploration for several years. Machinery was installed recently to sink on the ledge for 150 ft., which the management believes will reach the sulphide zone. Present plans call for development of a vein found in the tunnel level. J. G. Sullivan is the engineer in charge of operations.

✦ Operations at the Consolidated are reported to be progressing favorably. Development work continues in the 1,700-ft. level of the Sunshine, where a drift on the Sunshine vein is being driven west into the Consolidated area. Ore from the property will be handled through the new four-compartment Sunshine shaft when it reaches the 1,700 level. Extensive outside improvements have been under way during the past few months, flumes carrying a water supply being completed, buildings erected, and other work of a permanent nature carried out under the direction of Byron Wilson, enginner in charge.

✦ A development campaign at the Fairview mining property, 8 miles southwest of Bellevue, is supported by a Pocatello syndicate that includes Dr. W. W. Brothers, J. P. Halliwell, and Dr. O. F. Call. An option on the property has been given to develop and operate the claims. The company is to be known as the Money Metals, Inc. Dr. Wilson, formerly with the department of geology, University of Idaho, southern branch, examined the property several weeks ago and is said to have reported favorably. J. W. Wright, engineer and superintendent, is in charge.

✦ Under the supervision of A. M. Jensen, formerly in charge of operations at the Triumph, at North Star, on the East Fork, active work has started by the Hailey - Triumph Mines company in preparation for mining on an extensive scale. The mine will be unwatered to the 200-ft. level, and preliminary surface work will be completed by spring.

✦ Office headquarters of the Sunshine Mining Company have been transferred from Yakima to the mine, on Big Creek. All of the accounting departments of the mine will thus be consolidated at the property, eliminating much duplication of work and contributing to efficiency. The trust department of the Yakima bank of the National Bank of Commerce, Seattle, has taken over the transfer service of the Sunshine Mining Company. The corporation is said to have approximately2,200 stockholders, located in many parts of this country as well as abroad.

SULLIVAN ZINC PLANT, in Idaho, which is now operating at capacity. General view of plant shows roasting and leaching division on hillside. Cell room and power and melting plant are below the lower tracks

Mining in Michigan

1935-1936

✦ Mining activity in Michigan's principal gold area centered about the Ropes mine, which was dewatered during the year. Large stopes, mined about 50 years ago, were found on the bottom levels, whereas the upper levels appeared to be less exploited. The Calumet & Hecla Mining Company completed several diamond-drill holes in the Ropes area, but results were not reported. Later the company offered land owners 10 per cent of net smelter return for gold and silver lease rights on 40 acres in Marquette County, adjoining the Ropes gold mine. This offer was reported accepted. Continued activity in this region is expected during 1936.

The Copper Range Company found in a conglomerate bed, copper ore believed to be part of the Baltic lode in which the Champion mine is operating. The company is now rehabilitating an old shaft to develop the Baltic lode extension.

✦ The Copper Range company has met with no obstacles thus far in the sinking of its reinforced-concrete circular drop shaft in the Globe property—an innovation in shaft sinking in the Michigan copper district. At this writing, the shaft has been dropped over 60 ft. The water level will be reached at 90 ft., but with operation of pumps no difficulty is expected. The new shaft will connect with the old Globe shaft below the water level, which will be sunk to greater depth to develop the Baltic lode in Globe territory.

✦ At Calumet & Hecla's Ropes gold mine, in the Ishpeming district, more than 1,800 ft. of drifts have been opened on the bottom level. The East drift, which has been extended 300 ft., is now close to the 1,100-ft. mark. The West drift has been driven 800 ft. Diamond drilling continues to the north and south on the same level. Samples from the drills and the drifts are sent to Lake Linden, where they are assayed under the direction of C. H. Benedict, chief metallurgist of the company.

NEWS FROM WASHINGTON

By Special Correspondent

UNPRECEDENTED CONFUSION of budget plans now exists. Washington activities of January only set the stage for real budget making and new tax plans of Uncle Sam. Previously in these pages it has been pointed out that several financial burdens confront the Government which could not be portrayed in the January budget message of the President. The exact size of these is now more nearly evident, but the weight of the tax impact is less determinable.

Bonus bonds for the veterans will require ultimately about $2,300,000,000 disbursement, but many of these bonds will not be cashed for some time, due to the 3 per cent interest bait. They represent, therefore, in large part an increase in public debt, rather than an immediate new Treasury money raising problem. No one ventures to guess officially what the cash disbursement during the next eighteen months will be. But it looks like at least a billion. Perhaps substantially more.

The Supreme Court's more than expected vigor in overturning AAA has created new financial burdens on the Treasury, as well as reestablished a genuine politico-economic problem of farm relief. Despite official guesses, which are lower, it appears almost certain that $550,000,000 will be needed to be raised by taxes for these agricultural obligations. The cost between now and July 1, 1937, will be much greater than this; but a substantial part of the cost will remain in the public debt.

New Taxes

These and other financial burdens like relief could theoretically all be met without new taxes. That would, however, mean at least $6,000,000,000 of increase in public debt, and perhaps as much as $9,000,000,000, by July 1, 1937. (This date is the one around which forecasts usually center.) Few believe, as the President implies he does, that the United States can easily stand a total debt of $70,000,000,000. (Remember those unnamed big bankers?) And of the few, probably none of them want that figure approached at this astronomic billion rate. The conclusion is inevitable that some of the new fiscal responsibility will be met by new taxes *this session* of Congress.

Most conservative non-partisan estimators around Washington seem to be talking in terms of new excise taxes of the order of three-fourths to one billion dollars per year. Some of this load will be put on agricultural-products processers who, under the AAA decision, no longer can bear the whole load of agricultural relief. They will take some undoubtedly; but other industrial groups seem likely to be assigned a substantial percentage of the load as their particular burden. The mining industry is not being specifically mentioned, but processors of products of mines are just about as likely to be caught by the tax assessors of Congress as are food processors. Loud groans as to poverty, even claims of need for relief, of these other industries will probably do no good.

Despite new taxes the public debt is expected to be not less than $35,500,000,000 or $36,000,000,000 by July 1, 1937.

Mining Loans

RECONSTRUCTION Finance Corporation officials point out that applications for mining loans filed during the first quarter of the year can be examined and passed upon in time so that full advantage may be taken of the best working season. Attention is called to the fact that 60 per cent of the 1935 applications came in after Aug. 15. This was too late in the season to permit of examination in time for work to start before winter. Of the 348 applications that had been examined late in January, only 36 had been found acceptable. Attention is called to the fact that mining loans are not granted to make orebodies available. If there is a definite showing of ore, a $20,000 development loan may be made to open up the property. If enough ore can be blocked out to make a mining loan a reasonable risk, the money will be forthcoming, RFC officials state.

Neutrality

The technical significance of neutrality matters was forced to secondary position by recrimination and controversy over President Wilson's part in leading America into the World War. Nevertheless, international trade in commodities, like metals having war-time significance, remains an important part of the early program of the Congress. Legislation seems very certain to supplement, and to extend in time if not in scope the President's present authority, which expires the end of February.

Originally the Nye committee of the Senate had two objectives: First, there was a desire to take the profit out of war. Second, there was a hope that the country could be stirred in support of the rigid and absolute neutrality legislation which would make automatic the embargoes on American trade with belligerants with respect to many goods. The effort at profit limitation has not been able to show convincingly, even to headline readers of newspapers, that profit making during the World War had anything much to do with forcing this nation into the conflict. J. P. Morgan and his banking associates ended their appearance before the committee rather in a favorable position even as interpreted by the more radical press. This was most unexpected to Senator Nye. He had counted on the name of Morgan to damn munitions makers, even including mining and mineral industries which are admittedly secondary munitions trades.

At this point, the old personal grudge against Wilson of Nye, Clark, and a few other democratic and progressive Senators became dominant. They were able to bring out in quasi-confidential records the fact that Wilson actually authorized —almost encouraged—financing of the Allies and that his break with Bryan was in a substantial measure the result of this stand which Bryan regarded as violating our principles of neutrality. Political considerations have, of course, exaggerated this, but they have also brought out one or two conclusions which impartial observers feel are very important in probable future development in the export of commodities like copper. This is the way they reason:

Any action by Congress or by the President after a conflict starts which is not merely the application of fixed principles previously enacted becomes an act of partiality to belligerants. Hence if the nation really wishes to maintain neutrality in future conflicts it must fix by law, *in advance*, the rules governing exports and it must not leave any discretion with the President or attempt any subsequent legislative modification. The rules must apply to all belligerants alike, whether aggressors or aggrieved. They must apply to subsequent participants in conflicts as well as original belligerants. They must apply to specific classes of goods, named in advance, without option on the part of the President to select these goods. And the rules must apply immediately on the beginning of hostilities without option as to the effective date.

Prospectively, there is still much controversy over this line of reasoning between the President and Congress. The President wishes to have substantial dis-

cretion as to the scope of trading rules, the nations to which they apply, and the date of application. Nye and many of his supporters reason that Congress may not properly grant such discretion. In late January it appeared likely that this controversy will rage for some weeks to come, but that ultimately the President will be given some discretion, though probably not as much as under the present law.

It remains altogether doubtful, however, as to whether new and broader definition of goods which will come under restriction may be granted. At present only "arms, ammunitions, and implements of war" are restricted. For political reasons, neither the President nor Congress wishes to limit such things as copper, lead, and zinc—nor cotton either, for that matter. But the more vigorous neutrality advocates argue that this nation must do so. Decision on that question is most difficult to forecast.

Silicosis

Hearings during January have been held by a special subcommittee of the House of Representatives Committee on Labor to determine whether an investigation will be ordered of the importance of silicosis as a hazard in mining, construction, and other industrial activity. These hearings have resulted from a resolution introduced by Representative Marcantonio, a radical Democrat of New York City. His interest was inspired by greatly exaggerated reports of hundreds of deaths from silicosis alleged to have been contracted during the building of a big water-diversion tunnel for a power project at Gauley Bridge, West Virginia. The proposal of the resolution as introduced was that the Department of Labor should investigate silicosis as an industrial hazard in public-utility construction work. But the spectacular developments of the hearings have resulted in a much broader consideration, and the mining industry is certain to be affected.

A thorough and fundamental study of silicosis as a compensable industrial hazard may result. Federal attention to the subject does not necessarily imply any assumption of authority, but does make very likely much greater attention on the part of State authorities, who will be encouraged either to enact new legislation or more aggressively supervise dusty working conditions. This result is particularly likely if the final decision is to have the Department of Labor make the proposed inquiry. Something of the crusader spirit may be met if that plan is followed.

Many of the charges made at the hearings during January have been wholly irresponsible claims admittedly based on hearsay. Over 400 deaths and 1,500 cases still prospectively fatal are among the spectacular claims of non-technical or radical investigators. But regardless of the errors of statement, it is expected from the hearings that much more attention will be given to silocisis in Congress and in the Department of Labor than heretofore. Industrial executives who decline to be quoted individually are hoping that the Public Health Service and the Bureau of Mines will be called on to make factual and professional reports instead of having further political or crusading activity, with little constructive result to be expected. Both of the professional bureaus mentioned have done extensive work already and will be ready to go into the study thoroughly on short notice.

Public Lands For Mining

PUBLIC LANDS in Western states withdrawn from entry, for purposes of classification, by order of President Roosevelt in November, 1934, have been reopened for location of non-metalliferous mining claims. Location of metalliferous claims was not debarred by last year's order. The amendment, recognizing and allowing non-metalliferous claims, follows receipt by the General Land Office of numerous complaints from the Black Hills district of South Dakota, and also from Montana and Utah.

The amendment permits sale or lease under certain sections of the Taylor Grazing Act of any public lands in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, and Wyoming which the Secretary of the Interior shall determine are not needed for any public purpose. It includes all vacant and unappropriated public lands in the states listed which are valuable for non-metalliferous deposits and renders them subject to location under the mining laws, unless embraced in other withdrawals which prohibit or qualify the right to make locations thereon.

Mine Explosives

Reappraisal of the fundamentals required in a permissible explosive is being undertaken by the Bureau of Mines. Every characteristic is to be considered and entirely new standards will be set wherever necessary in order to establish the most modern possible requirements with due regard to both safety and effectiveness. All available recommendations regarding permissibility standards, methods of testing, or other explosives problems are being considered and a broad program of experimental work and field study is being planned.

This work has been given impetus by the appointment, effective at once, of Dr. Wilbert J. Huff as chief explosives chemist of the Bureau. Dr. Huff was formerly, in 1919-1920, connected with the Bureau, engaged in the explosives testing at the Pittsburgh laboratories. Then he was associated with the research division of The Koppers Company, and for the past twelve years has been professor of gas engineering at Johns Hopkins University. Dr. Huff is continuing for the remainder of the college year his work as professor, but is devoting part of his time to the Bureau work, with headquarters in Washington.

Experimental investigations are being continued at the Pittsburgh laboratories of the Bureau under members of the staff who have carried on during the interim since the retirement of Dr. Charles E. Munroe, some years ago. Underground studies at the Bruceton experimental mine are also continuing. The laboratory work now includes studies of the fundamental physics and chemistry of ignition, flame travel, chain reactions, and related subjects. In addition, considerable laboratory work will be initiated during the coming summer on explosives themselves. There has been no interruption of permissibility tests; and listing as "permissible" is still contingent on meeting present standards, which will remain in force until the new investigations have advanced far enough to warrant complete revision.

Canadian Mine Purchasing

Expenditures of mining and milling enterprises of the Canadian industry have been summarized in a document[1] of the Dominion Bureau of Statistics recently published, which stirs Washington interest considerably. This interest is, of course, inspired by the hope that American business will be able to secure a share of this market.

Considerable detail is given in the original publication, showing for each province the aggregate expenditure for each of about 50 classes of commodities or services. The following tabulation summarizes for the Dominion as a whole the major items of mine spending, the data being applicable to the calendar year 1934, the latest for which figures are available.

Freight and express	$12,000,000
Power	9,150,000
Fuel	8,700,000
Machinery	7,850,000
Explosives	5,300,000
Lumber and timbers	4,150,000
Insurance	3,550,000
Steel, rope, etc.	2,800,000
Flux, refractories, etc.	2,400,000
Electric equipment	2,350,000
Chemicals	2,300,000
Pipe and casing	1,950,000
Construction material	1,950,000
Drills and supplies	1,850,000
Cars and track	1,800,000
Others	8,000,000
Total	$76,100,000

[1]"Special Report on the Consumption of Supplies by the Canadian Mining Industry, 1934," published by authority of Hon. W. D. Euler, Minister of Trade and Commerce, Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Branch, Ottawa, Canada.

Tintic Standard Mining Company of Utah Buys Control of Eureka Lilly

Property Purchased From Chief Consolidated Mining Company Will Be Developed to Deeper Levels—Cardiff Mine, in Big Cottonwood Canyon, Reopened—Students From South Africa Visit Utah Mines and Smelters

CLOSING DAYS of the year were characterized by a number of events that give promise for a period of increased activity in Utah during 1936. For a price of $360,000, the Tintic Standard Mining Company purchased all of the interest of the Chief Consolidated Mining Company in the Eureka Lilly property, consisting of 127 acres, adjoining the Tintic Standard mine. Completion of this transaction gives the Tintic Standard control of the Eureka Lilly. The Tintic Standard and Eureka Lilly mines are connected from the 1,250 level of the Tintic Standard No. 2 shaft. Ore from the Eureka Lilly will be shipped from the Tintic Standard shaft. An extension on the Tintic Standard 1,400 level, according to James W. Wade, general manager, will be driven into Eureka Lilly ground. The Eureka Lilly shaft will be deepened 140 ft., to afford a second connection on the 1,400 level. About 200 ft.. of drifting will be necessary to make this connection in addition to the sinking. The Eureka Lilly has been producing 1,500 tons of gold, silver, and lead ore monthly from near the new Eureka Lilly shaft in the southeast end of the property.

✦ Another old mine to take a new hold on life is the Cardiff, in Big Cottonwood Canyon, 25 miles southeast of Salt Lake City. Pumps capable of handling 450 gal. a minute have been installed, and the work of reopening the lower levels, according to Lynn Thompson, general manager, is making steady progress.

✦ Ore reserves of the Park City Consolidated mine, at Park City, were substantially increased, according to the report of Gloyd W. Wiles, superintendent, by the recent opening above water level of a new oreshoot in the Silver vein. Development of this ore will aid considerably in keeping production up to normal while the company continues its drift on the 900 level to connect with the North Crosscut from the Ontario No. 2 drain tunnel and at the same time sinks the 401 winze.

✦ At the Park City Development property—A. L. Hurley, manager—all underground equipment is being replaced with electrically driven machinery with the object of increasing production to 100 tons daily. A new compressor, two new electric hoists, a new ventilating fan, and an air line are being installed, and skips will replace the buckets used in the winzes below the 1,100 level. A new ore discovery on the 1,300 level, followed for 50 ft. in a northeast direction, has enhanced the outlook for the mine. East and southwest of the shaft the company is mining a good grade of silver-gold ore.

✦ Thirty-eight students of the University of Witwatersrand, Johannesburg, South Africa, headed by Professor S. N. Hoffenberg, arrived in Salt Lake City on Jan. 15, to visit mines and metallurgical plants in Salt Lake Valley and the vicinity.

✦ During the latter part of the old year, the Mammoth Mining Company, operating at Mammoth, Tintic district, Utah, announced the payment of a 5c. per share dividend on Jan. 2. Payment of this dividend — $19,766.10 — increases the grand total of disbursements to $3,177,887.10. Discovery of a high-grade body of gold ore on the 2,100 level greatly improves the outlook for the old property, operated continuously by the McIntyre family since 1872.

✦ Utah non-ferrous mines increased production during 1935 to a total valued at $31,000,000. This is nearly $9,000,000 more than the value of production for 1934, amounting to $22,656,000, and nearly double the production of 1933, $16,324,369.

✦ In Bullion Canyon shipments are being made from the Valdasia, Great Western, Tushar, and Gold Strike. The Wedge is also active. A Philadelphia group is cleaning out the Franklin tunnel of the Murray Development Company, preparatory to driving a tunnel to crosscut the entire vein system.

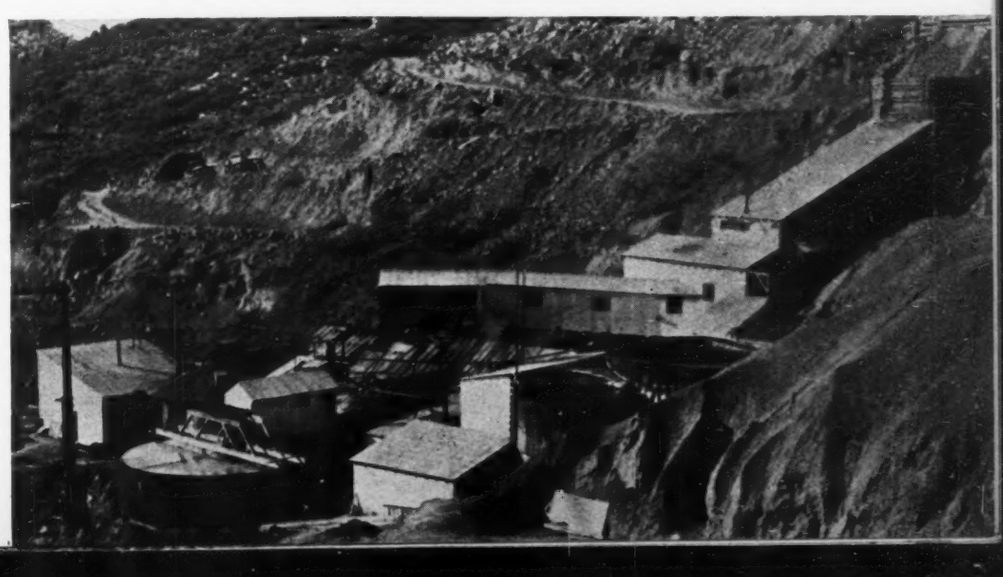
Air Conditioning Mines

AIR CONDITIONING of mines for workers' comfort as well as for safety is being studied by the Bureau of Mines. Reconnaissance is now in progress in the Coeur d'Alene district, where three of the Bureaus' investigators are studying practical aspects of the problem. This work has been initiated as a part of the study authorized last year by Congressional appropriation intended for the prevention of silicosis and other dust hazards. The Bureau hopes that as an incident to securing atmospheres free from dangerous silicate dusts some benefits in comfort of working conditions may also be achieved.

Among the technical problems involved are those incident to any general ventilation study. For example, it is not yet clear to what extent lower temperature, lower humidity, and air movement may be factors in improved working conditions. All are being studied.

If the present appropriation is continued another year it is expected that additional field inquiries will be made. For example, in the deeper mines of Arizona, the deep sections of the Comstock (especially if silver stays high), and perhaps other areas. This field work is being carried out in parallel with small-scale laboratory studies of the methods for determining dust, and for identifying the types of dust that may be most significant, as distinct from mere total dust determinations.

GEYSER-MARION MINING Company's new 150-ton cyanide plant at Mercur, Utah. The ore is mined by steam-shovel method from an open cut. Tailings from the old mill averaging about $2.50 per ton in gold will also be treated at this mill



NEVADA'S BOOM TOWN OF WEEPAH, which had a gold rush in 1927, now supports a 250-ton flotation mill which is fed by ore mined from an open pit, the floor of which measures 118 ft. wide, containing gold ore of milling grade. This deposit is also developed underground by the Horton Shaft, shown on the left. The property is operated by the Weepah Nevada Mining Company in Esmeralda County, Nev.

Grass Valley District, California, Active With Mining Transactions

Empire-Star Mines Company Reported Interested in Nevada City and Banner Mountain Mines—Central and Northern Placer Regions Supporting Two More Dredging Operations—Oro Fino Mine, in Ophir District, Being Unwatered

TWO NEW DREDGES have been added to the existing fleet operating in central and northern California. In Sierra County, the Junction City Mining Company, H. L. Sorenson, president, has placed in operation its 9-cu.ft. dredge, the former Madrona unit rebuilt by Yuba Manufacturing Company, of San Francisco, near Junction City, and Sacramento Gold Dredging Company has started up the 6-cu.ft. dredge completed recently. Both dredges are reported to be working satisfactorily.

✦ H. G. Peake and T. F. Nicholls, dredge operators, are reported to have acquired a placer deposit on Antelope Creek, near Loomis, and have moved in the 3-cu.ft. dredge dismantled recently in Canyon Creek, Georgetown. The boat will be reconstructed at once, and when completed is expected to handle about 2,000 cu.yd. a day.

✦ Preparations are under way at the Carson Hill mine, at Melones, to unwater the property below the 3,000-ft. level as a preliminary to development work planned on the 4,375-ft. level. No work has been done on this level, which is reached through a winze sunk from the 3,000-ft. level, since 1923. The 1,000-ton mill is treating about 25,000 tons of ore a month. Charles H. Segerstrom is president of the Carson Hill Gold Mining Corporation, owners of the Carson Hill property.

✦ Growing activity is reported in the Grass Valley-Nevada City district, with several transactions in mining properties in recent weeks. The Empire-Star Mines Company is reported to have acquired the California Consolidated & Gold Tunnel properties, in the heart of Nevada City, and the North Banner mine, near Banner Mountain, and J. M. Hoff, said to be representing the Phelps Dodge Corporation, has optioned the Never Sweat, St. Louis, Federal Loan, and other mines in the Willow Valley area. Rehabilitation and unwatering work has been started at several properties by both companies.

✦ Additional equipment is to be installed at the King Solomon mine, near Black Bear, Siskiyou County, purchased recently by the A. O. Smith interests, of Milwaukee, Wis. The soft gold-bearing surface ore is mined by bulldozers and power shovels and delivered to the 300-ton mill via a 2,500-ft. aërial cable tram. Deeper mining is planned.

✦ At the Oro Fino mine, in the Ophir district, near Auburn, acquired recently by San Francisco and Nevada County interests, unwatering operations have been started under the direction of Albert Crase, manager. This is to be followed by systematic development work and diamond drilling with the object of determining the production possibilities at depth. Erection of a mill is contemplated. The property comprises 400 acres, and the 840-ft. Oro Fino shaft has not been worked since 1922.

✦ Charged with making false statements in a report to the Securities and Exchange Commission, five promoters and officials of the Big Wedge Gold Mining Company were indicted on Jan. 9 by the District Grand Jury in Washington, D. C. This is the first case prosecuted under the Securities Act. E. J. Harrison, promoter; William Molloy, president; Max E. Zimmon, secretary; Hy Schwartz, counsel, and Harold A. Pelton, consulting engineer and superintendent, were named as responsible for alleged false statements on the corporate organization and the value of the mining property. Editorial reference to this case before the SEC was made in *E.&M.J.*, May, 1935.

✦ In the Lincoln placer district, J. F. Knapp, of Oakland, has taken over the Clark property, worked until recently by C. N. Chittenden, of Lincoln, and plans early installation of a new plant.

✦ The Yellow Aster Mine, owned and operated by the Anglo American Mining Corporation, Ltd., is milling 200 tons of gold ore per day. A crushing and screening plant and a 50-stamp mill with amalgamation plates constitutes the principal milling equipment. The new cyanide plant, which was put into operation last September, is treating 1,150 tons per day of mill tailings accumulated from early operations; also tailings from the present milling operations. Approximately 525 tons are treated in the slime plant and 625 tons in the sand plant. The personnel includes A. W. Frolli, manager; J. A. Hamner, mine and mill superintendent; C. L. Cooper, cyanide plant superintendent.

✦ The fifteen-month strike at the Argonaut company gold mine was settled on Jan. 10, when members of the Mother Lode Miners' Union of Jackson voted to return to work. About 100 men will return to work soon under improved working conditions and an increase in pay of 50c. per day. The miners' union at Jackson consists of about 580 members, most of whom have returned to work in other mines on the Mother Lode where minor labor difficulties recently ended.

✦ About 25 men are employed in development work at the Plumbago mine, near Alleghany, Sierra County, preparatory to reopening the property. Ore obtained from this work is treated in the old 20-stamp mill reconditioned recently. A. B. Campbell is in charge of operations. At the neighboring Sixteen-to-One Extension mine, underground

development work is proceeding satisfactorily, and further deepening of the two-compartment shaft for exploratory purposes is contemplated. Equipment installed recently includes a 100-hp. compressor and a 50-hp. hoist. G. W. Hallock is general manager. Another well-known mine in the district, the Morning Glory, has been optioned by W. W. Esterly, Grass Valley, who plans early commencement of operations. The mine has been idle for several years. Equipment at the property includes a five-stamp mill.

NEVADA

✦ Reopening of the Omco gold mine, east of Mina, in Mineral County, has involved remodeling and enlarging the old 50-ton cyanide mill and extending a power line to the plant from the Simon Silver-Lead property, 4 miles to the east, replacing diesel power. The mine, owned by the Carrigan estate, of San Francisco, has been idle since 1921. Engineers' reports indicate sufficient available ore to operate the 100-ton plant for at least a year. L. B. Spencer, of Mina, Nev., is in charge.

✦ Gold & Silver Circle Mines, Inc., formerly Gold Circle Consolidated Mines, has shipped four bars of gold-silver bullion to the mint at San Francisco from its 75-ton cyanide mill in the Gold Circle district, western Elko County. Ore is drawn from stopes in the Elko Prince and Missing Link mines of the company, which plans a long, deep-level drainage tunnel to open these and several more of the group of adjacent mines at depth. Noble H. Getchell, of Battle Mountain, Nev., is president and manager. The company's Betty O'Neal silver mine, 12 miles southeast of Battle Mountain, is being reopened.

✦ Further increase in mill capacity is said to be planned by the Reliance Mining Company, which has acquired the War Eagle mill and two mines that have been productive for several years in the Manhattan district, central Nye County, and 45 miles north of Tonopah. Plans of the company involve the reopening of the old Mustang and other adjacent claims that produced rich gold ore in the early period of the camp. Randolph Crossley, of Pasadena, is president and manager.

✦ Two prospect tunnels and a crosscut on the 200-ft. level of the main shaft are being driven on gold property at Olinghouse, southeastern Washoe County, lately taken under option from Gus Shavee by United States Senator Key Pittman, of Nevada, and John J. Raskob, of New York. The optionees have formed the Gold Horn Mining Company to acquire and develop the property, which already has produced some high-grade ore under the new management. F. J. DeLongchamps, of Reno, is in charge.

Bagdad Copper Mines, in Arizona, Reopen Following Long Shutdown

Concentrates From Mill Sent to Smelter in El Paso—Mohawk Extension to Construct a Smelter—King Tut Placers Start Operations—Gold Standard Mines, in Katherine District, to Enlarge Custom Mill

BAGDAD COPPER, at Hillside, Ariz., has resumed production after several months of preliminary work following the four-year shutdown. The mill is operating sixteen hours a day, producing 50 per cent copper concentrates for shipment to the El Paso smelter. Two new stopes have been developed to permit increased production. The mill tonnage is expected to reach 500 tons per day by spring. George G. Thomas is general manager.

✦ Bunker Hill Arizona has completed the 100-ton smelter at Sombrero Butte. Fred W. Kuenzel, who supervised construction, has announced that he will start a 300-ton smelter at Mammoth for the Mohawk Extension mine.

✦ King Tut Placers began operations on Jan. 2 with a ceremony attended by officials and guests. The property is in Lost Basin, west of Kingman, near Boulder Lake. The recovery plant has a capacity of 70 cu.yd. an hour. Water is supplied through a 10½-mile 6- and 4-in. welded pipe line delivering 154,000 gal. per day.

✦ A contract has been given to the Vukoye brothers, of Kingman, for development work on the Klondyke mine, in the River range northwest of Chloride. This property was recently leased by Thomas F. Ryan, III, following a trip of inspection with W. Val DeCamp. Ore will be shipped to the Tom Reed or Gold Standard mills.

✦ Yarnell Mining, at Yarnell, which has recently placed in operation a 50-ton mill, reports an extensive oreshoot located over a distance of 300 ft. by crosscuts from the hanging-wall drift. The property is operated by W. E. Fenwick.

✦ Consolidated Gold Mines, at Dos Cabezos, will increase milling capacity from 25 to 100 tons daily. The shaft will be sunk 100 ft. from the 600 level. Operations are directed by A. B. Wadleigh, mine superintendent.

✦ New Cornelia Branch of Phelps Dodge, at Ajo, is reported to be producing 8,000,000 lb. of copper monthly, operating near capacity at 15,000 tons per day.

✦ Gold Standard Mines is planning to increase milling capacity to handle increased output from its own mines as well as to furnish greater custom capacity for mines in the Katherine district. At the annual stockholders' meeting, J. Liska, of Chicago, was elected president J. P. Pearson, of Moline, vice-president; and Richard DeSmet, of Kingman, treasurer and general manager. DeSmet has been in active charge of the property since last July.

✦ The Dixie Queen, near Chloride, has been leased by J. L. Harper, of Seattle. Hardinge-Hadsel crushing equipment with amalgamation-cyanidation treatment will be used in the mill.

✦ Golden Falcon Mining has leased a property at Cleator from Arizona Western. The gold-silver-lead ore will be developed by a 250-ft. adit to crosscut into the vertical vein at the 175 level and a 150-ft. drift on the vein. J. S. Allen, of Prescott, is general manager.

✦ The Cornucopia mine, at Groom Creek, near Prescott, has been leased by W. G. Hofawger and O. W. Walker. A shaft has been sunk 50 ft. and a tunnel driven in 150 ft. Four shipments of ore have been made.

✦ Bluebird Mining is planning a 25-ton plant using blankets, amalgamation, and flotation. The property, in the Old Hat district, is being developed by Capt. F. W. De Valda, of Oracle.

✦ The Eldorado mine, abandoned since the destruction of the O.K. mill by fire in 1906, has received Federal approval for a Class B RFC loan.

✦ The Telluride Chief mine has located another vein of shipping grade ore, parallel with the main vein, by crosscutting. The mine is in the Walapai Mountains, east of Kingman.

✦ Tombstone Extension is starting a second shaft about 500 ft. from the main shaft. The work is under the direction of C. M. D'Autremont.

✦ An option on a 7½-mile strip of the Gold Basin property, in the Quijota district, 90 miles west of Tucson, has been taken by Mrs. V. M. Willard, of Los Angeles.

✦ Magma Copper is making changes in the smelter to adapt it to natural gas to be supplied through a 45-mile branch line from the El Paso-Phoenix pipe line. The Copper Queen Smelter of Phelps Dodge was changed to natural gas in 1931, when the main line was laid.

Tri-State Region Continues to Prepare for Greater Activity

Summary of Progress During 1935 Shows Zinc Production Increased 20 per Cent and Lead 5 per Cent—Mines in Webb City District Being Dewatered at a Rapid Rate and Others in the Baxter Springs District, in Kansas, Will Reopen

TRI-STATE • Oklahoma, Kansas, and Missouri, comprising the Tri-State region, produced during 1935, according to the Tri-State Zinc and Lead Ore Producers Association, 401,969 tons of lead and zinc concentrates, of which 361,672 were zinc and 40,297 were lead. This represents an increase of 20 per cent in zinc and about 5 per cent in lead above production in 1934. The increased demand for zinc in the present general revival of industry encouraged a definite trend in numerous small operations in the Oklahoma-Kansas section. Instead of reconditioning old mills having capacities of about 40 tons, already on or near the mines, ore is shipped to the Central Mill, which was constructed in 1932 by the Eagle-Picher Mining & Smelting Company. This mill treats about 5,000 tons of ore daily, some of which comes from properties 35 miles away.

The principal lead producers in the region were Eagle-Picher Mining & Smelting Company and Commerce Mining & Royalty Company. American Smelting, Refining & Mining Company entered the Joplin field in the early part of 1935 as a lead buyer for the first time in ten years.

Several mines in the Oronogo section were dewatered during the year and placed in operation. Waco, Diamond, Webb City, Badger, and Carthage also renewed activity. Mining was greater in the Tri-State during 1935 than in the last seven years. Many mills were constructed or rebuilt to treat zinc tailings, the results of which accounted for about a 20 per cent of the total zinc production. In the Oklahoma region the Tri-State Zinc, Inc., a subsidiary of Consolidated Gold Fields of South Africa, built a tailing mill at Pitcher. The Hockerville field also witnessed more activity.

A strike affecting 4,500 men was called on May 8 by the International Mine, Mill and Smelter Workers Union, which sought union recognition and higher wages. The strike lasted for about a month. This action checked production, which was later reflected in decreased zinc stocks, and further intensified mining activities toward the end of the year.

✦ The water level in the old Tri-States mines in the North Webb City field, which are being unwatered, is going down rapidly, and it is believed examinations of these properties will be possible within the next thirty or sixty days. Two 14-in. Pomona pumps have been installed at the Good shaft, which are pumping about 7,000 gal. of water a minute. These pumps were moved to the Webb City area from the Oronogo district. Drill rigs are being operated in the Oronogo and Webb City field by the Eagle-Picher and the American Zinc, Lead & Smelting Company.

✦ Muncie mine, a property of the Federal Mining & Smelting Company, near Treece, Kan., will soon be reopened, according to L. G. Johnson, superintendent, of Baxter Springs. The plant has been idle since 1929. Federal closed all of its properties in 1930 and has operated but one mine, the Jarret, since that time. The Jarret was closed, however, on May 8, 1935, and has not been reopened.

✦ Mutual Mining Company, owned and managed by Guy Waring, of Webb City, has been making daily shipments from its mine in the Oronogo district to the Central mill of the Eagle-Picher Mining & Smelting Company. The Mutual and the Webb City Lead & Zinc Company, operating the old Unity mine, at Oronogo, are shipping about 1,000 tons of crushed ore a day to the Central mill, and this tonnage is expected to be increased to 1,500 by Feb. 1. The Mutual is planning to start operating the Skidoo very soon.

✦ The Scott mine of the Century Zinc Company, south of Baxter Springs, is being dewatered and will be reopened some time in February, according to J. H. Trewartha, superintendent.

Many Special Features Planned For Annual Meeting of A.I.M.E.

Diversified Program Deals With Aviation in Mining, Mineral Economics, Rare Metals and Minerals, Mining and Metallurgy of Metallics and Non-Metallics, Mining Methods and Geology—Trip to Schenectady Scheduled on Feb. 21

THE ANNUAL MEETING of the American Institute of Mining and Metallurgical Engineers will be held in New York City from Feb. 17 to 21 inclusive. At the annual dinner President H. A. Buehler will present the William Saunders Medal to Clinton Hoadley Crane and the certificate of Honorary Membership will be presented to Robert Peele. The Robert W. Hunt prize will be awarded to C. C. Henning, of Pittsburgh, and the J. E. Johnson, Jr., award will be given to Francis Hearne Crockard, of Thomas, Ala.

Present-day technology brings the mining and metallurgical engineer closer to new fields of industry, where he plays a part in the development trend. The importance of transportation and the metals involved in this industry is a striking example of research, from the mines to the laboratory. A symposium on this subject is scheduled for Feb. 20. Rare metals are a part of this new trend, and they will be mentioned on the same day. In the field of milling a description of nozzle crushing and the separation of hematite by means of hysteric repulsion attract attention. Electrocapillary amalgamation will be of interest to all seeking greater gold recovery. Mine safety and health questions will be discussed from the floor, and geophysics in the Antarctic, also on the program, will be of interest to the geologist. A summary of the sessions of particular interest to members of the metal-mining industry follows:

Monday, Feb. 17

Morning—Mining Methods; Geophysical Prospecting, Nonferrous Metallurgy.
Afternoon—Aviation in Mining; Industrial Minerals; Non-metallics.
Evening—Institute Dinner-Smoker.

Tuesday, Feb. 18

Morning—Physical Metallurgy; Crushing and Grinding; Magnetic Separation and Milling Practice.
Afternoon—Mineral Economics; Institute of Metals Division; Flotation and Gold Milling, Mining Geology.
Evening—Informal Dance.

Wednesday, Feb. 19

Morning—Aluminum; Industrial Minerals Division; Geophysical Methods of Prospecting.
Afternoon—Industrial Minerals Division; Geophysical Prospecting.
Evening—Annual Reception and Dance.

Thursday, Feb. 20

Morning—Rare Metals and Minerals; Metals in New Transportation; Ground Movement and Subsidence; Health and Safety in Mines.
Afternoon—Health.

Friday, Feb. 21

Morning—All-day excursion to Schenectady, N. Y., where members and their friends will be the guests of the General Electric Company.

Mining Congress Elects Officers

The annual meeting of the American Mining Congress was held at the Waldorf-Astoria, in New York City, on Jan. 14 and 15. Only routine business was transacted, including election of officers for 1936 and adoption of resolutions. Reports on the Mining Congress activities during 1935 were presented by Secretary J. D. Conover and Treasurer E. V. Daveler, and by chairman of committees on taxation, legislation and other matters.

Officers elected for 1936 were: President, Howard I. Young; vice-presidents, D. D. Moffat, J. B. Putnam, and D. A. Callahan; secretary emeritus, J. F. Callbreath; secretary, J. D. Conover; directors for three years, D. A. Callahan, Clinton H. Crane, W. J. Jenkins, J. B. Putnam, and J. D. Francis.

The following principles and measures were urged to be made effective in the conduct of national affairs: a balanced budget; eliminate bureaucracy; let employers and organizations of employees be subject alike to legal responsibility for their conduct; substitute direct relief at reasonable subsistance rates for work relief; make no changes in tariff rates through trade agreements with foreign countries without specific approval of such changes by Congress after public hearing; deal fairly with the taxpayer in the enactment and administration of tax laws.

University of Washington Ninth Mining Institute

The Ninth Annual Mining Institute conducted by the College of Mines, University of Washington, Seattle, concluded its week of sessions on Jan. 25. High lights of the Institute were the joint dinner and meeting with the North Pacific Section of A.I.M.E. on Jan. 21. Thomas B. Hill, supervisor of the division of mines and minerals of the State Department of Conservation and Development, outlined the purposes and aims of this newly created department. H. C. Garrett, Registrar of Companies and Superintendent of Brokers for the Provincial Government of British Columbia, presented an analysis of the "Securities Act" and recounted experiences and interpretations of the law as it applies to mine promotions in British Columbia. His conclusions were that the act had been of decided advantage to mining by diverting increased amounts of money raised from securities sales to development of properties and that fraudulent promotion had been discouraged.

A motion-picture talk by Andrew Olson on "Drag-Line Methods in Gold and Platinum Mining" attracted much interest. One day was devoted particularly to Alaska. Papers covered recent operations in tin mining on Seward Peninsula; mining exploration in Southeastern Alaska; and gold-saving methods in placer mining. The relationship of administration of national forest areas to prospecting and mining was ably covered by John C. Kuhn, supervisor of the Snoqualmie National Forest. The general subject of mineral resources of Washington formed the subject of an afternoon session held jointly with local mining associations.

A feature of the Institute this year was a series of luncheons each day at which special attractions were provided. On one day the Mines Society, Student Chapter of A.I.M.E., presented three of its members, who talked on their observations and experiences in various mining camps at which they had worked.

Mechanical Improvements Planned in Iron Country Will Boost Output

Substantial Increase in Shipments From Lake Superior Region Now Being Followed by Underground Development in Preparation for Larger Tonnages This Year—Washing Plants to Be Modernized

IRON ORE MINING in Minnesota in 1935 varied little from the record for 1934, with the exception of additional tonnage. The shipments from Lake Superior district totaled 28,078,055 tons, compared with 22,027,055 tons in 1934, a gain of 6,051,000 tons. Of this increase, Minnesota supplied 4,254,901 tons. Very little change in mines producing this tonnage was noted, with the exception of the Oliver Iron Mining Company, which secured its tonnage from the Coleraine, Hibbing, Chisholm, and Eveleth districts. In previous years the Virginia district was the heavy producer, but it was idle this season. Heavy shipments of ore for next year must be anticipated from the number of underground mines working this winter, most of them five days a week. On the Vermilion range, the Oliver Iron Mining Company is operating the Pioneer, Sibley, and Soudan mines, and the Pickands, Mather Company is working the Zenith mine. On the Mesabi range, the Oliver iron Mining Company has the Spruce, Leonidas, Morris, and Godfrey in operation, and independent operators are busy at the Sargent, Mississippi, LaRue, Alexandria, Agnew, St. Paul, Stevenson, Lincoln, Commodore, and Julia mines. The operation of these underground properties is also necessary to remove part of the load from the Poor Commission and give the miners a chance to work.

Very little new machinery was purchased at the mines last year. Butler Brothers bought a new 4-yd. electric shovel from the Marion Steam Shovel Company in November and it is being used in winter stripping. The Julia mine, at Virginia, is being placed in operating condition by the Republic Steel Corporation, but most of the machinery installed is from other properties.

At the Soudan mine, near Tower, Minn., a radical change in drilling practice was put into effect on Dec. 1, when the mine started using detachable bits of Ingersoll-Rand make. This mine has been operating for over fifty years and has the hardest iron ore in the United States. B. A. Strachan, of Ely, Minn., is district superintendent.

Only one mine lease was surrendered in 1935—the Duncan, near Chisholm, Minn., by the Oliver Iron Mining Company. The State owns the fee and estimates a low-grade tonnage of 1,500,000 tons left in the property.

Due to the purchase by Republic Steel Corporation of the Corrigan, McKinney Steel Company, the following operating mines were added to the corporation's list in Minnesota: Commodore, Julia, Stevenson, and St. Paul. With this change, the personnel of the operating department was also revised, when J. Murray Riddell was shifted to assistant manager under John Nelson, manager at Duluth, Minn.

Two pronounced trends for improvement during the year lie in the mechanical and electrical field. The operators are cutting down the weight of their shovel dippers, due to improved design, and increasing the size to make up the reduced weight in additional ore handled. The 4-yd. dippers are being replaced with 4½-yd. units, giving over a 10 per cent increase in production, with no additional load on the shovel. This increase will pay for the new dipper in one season's operation. The second improvement is the new-style high-voltage electric cable for pit shovels. Oliver Iron Mining Company replaced over 15,000 ft. of this old three-conductor cable with a new design, with heavier ground wires and heavier insulation.

Activity this winter on the ranges is 100 per cent better than a year ago. Most of the washing plants on the west end are planning revisions and improvements that mean new machinery, and changes must be completed by May 1 for next season. Added stripping programs at three of the mines also account for this increase.

PERSONAL ITEMS

V. V. Clark, mining engineer, of Colorado Springs, has sailed for Manila on a professional engagement.

S. H. Watson has left Selukwe to assume the post of Assistant Government Mining Engineer at Bulawayo.

C. H. J. Clayton has been appointed chief mining engineer to the De Bernales interests in Western Australia.

G. J. Hallis recently assumed the position of general superintendent of the Corduroy mines, in Western Australia.

Sydney H. Ball, of Rogers, Mayer & Ball, is spending a couple of weeks in professional work in northern Ontario.

Ernest V. Pearce has been appointed chairman of the board and managing director of Consolidated Tin Smelters, Ltd.

H. J. Aspoas is now Mining Commissioner for the District of Pilgrim's Reef, South Africa, and Assistant Inspector of Mines.

Elmer A. Benson, the new Senator from Minnesota, has been assigned to service on the Mines and Mining Committee.

D. H. Angus, of Haileybury, Ontario, has recently been appointed a director of McWatters Gold Mines, Ltd., Rouyn, Quebec.

E. J. Bunbury has been appointed director and has accepted the chairmanship of the Anglo Oriental Mining Corporation.

W. H. Marquette, mill superintendent for both Hillside mines and Davis-Dunkirk mines, is located at 310 Union St., Prescott, Ariz.

J. W. Henderson, formerly mine superintendent for the Big Jim, Oatman, is now with the Mammoth-St. Anthony, Mammoth, Ariz.

R. H. Dye, formerly manager of the Vipond mine, has been appointed general superintendent of Dome Mines at Porcupine, Ont.

W. M. Snow, consulting engineer, of Phoenix, Ariz., has been appointed an examining engineer with the mine loan division of RFC.

H. J. du Plessis has been appointed Mining Commissioner for the Mining District of Barberton, Transvaal, and Assistant Inspector of Mines.

G. C. Lingle, of Globe, Ariz., is president of Regal Asbestos Mines, succeeding E. Schaaf-Regelman, who died in Germany last spring.

J. F. Mitchell-Roberts, metallurgical engineer with Oliver United Filters, has left New York for a four months' trip to Japan, China, and the Philippines.

J. J. Jakosky, consulting engineer of Los Angeles and technical director of International Geophysics, is engaged in professional work in the Mid-West.

William Val DeCamp recently sailed to Bolivia, where he will be consulting engineer for mining interests of Dr. Mauricio Hochschild near Pulocayo.

A. S. Knight, for five years manager of Geduld Proprietary Mines, has been appointed manager of East Geduld mine, in succession to the late E. P. Cowles.

A. R. McGuire has reopened the Old Channel hydraulic mine, near Galice, Ore. He has a crew of 25 men and the operating season is estimated at seven months.

G. L. Ditchburn, for several years metallurgist of Golden Plateau, N. L., Queensland, has accepted the position of metallurgist of Emperor Mines, Ltd., Tavua, Fiji.

U. S. Bureau of Mines Photo
Dr. Wilbert J. Huff

Dr. Wilbert J. Huff, of the engineering faculty of Johns Hopkins University, has been appointed chief chemist of the Explosives Division of the Bureau of Mines, Department of the Interior. Dr. Huff was a member of this division, in charge of chemical work at the Pittsburgh station, after the World War, and there carried on a number of researches, one of which, on the corrosion of firearms, led to the widespread introduction and use of present-day non-corrosive ammunition. He is a graduate of Yale College, with general honors, and special honors in chemistry, and was Loomis Fellow in Yale University, from which he received the degree of Doctor of Philosophy in 1917.

J. G. Andrae has left Seattle, Wash., for Nome, Alaska, where he is superintendent for Greenstone Mines, Inc., which has placer operations on Osborne and St. Michael's creeks.

Thomas N. Armstrong, metallurgical engineer, has joined the technical staff of The International Nickel Company. His headquarters will be in the New York offices of the company.

Arthur L. Walker and Mrs. Walker have left New York for Mazatlan, on the west coast of Mexico. They will spend some time in Mexico City, Guadalajara, and other Mexican cities.

F. W. Cowperthwaite has accepted the position of superintendent of mines for the Telluride Mining & Milling Company, at Telluride, Colo. This property is the old Smuggler-Union mine.

W. Hobart Duff, metallurgist, and a principal in the firm of Crossle & Duff, Pty., Ltd., representatives of The Dorr Company, returned to Melbourne, Australia, early in January following a world tour.

R. T. Mishler, formerly general manager of the Boston mine, Mokelumne Hill, in California, has returned to Fresnillo, Mexico, where he is now assistant general manager of the Fresnillo Company.

S. Guy Alderson is on holiday in Montreal from Kenya. He returns there in April to relieve his brother, **W. P. Alderson,** who is developing a gold property near the western shore of Victoria Nyanza.

Richard W. Unger, formerly mill operator for San Juan Metals Corporation at Telluride, Colo., is now operating in the recently completed 50-ton flotation mill of the Fine Gold Mining Company at Railroad Flat, Calif.

H. W. Hard, metallurgist, until recently with South American Development Company at Portovelo, Ecuador, sailed recently for Manila, P. I., to join the staff of Benguet Consolidated Mining Company at Baguio.

Henry Ross Taylor, formerly mill superintendent at Anyox, has been retained by Osoyoos Mines, Ltd., as consulting metallurgist to supervise the erection of a 50-ton flotation plant at the Dividend mine, Osoyoos, British Columbia.

Dr. A. A. Potter, dean of the Schools of Engineering, Purdue University, Lafayette, Ind., has been unanimously nominated as president of American Engineering Council for 1936 and 1937, to succeed **J. F. Coleman,** of New Orleans.

Samuel H. Dolbear, New York consulting mining engineer, left the United States on Jan. 17 for a trip to Korea to make an examination of the Great Nurupi mine. He expects to be absent from New York for three or four months.

John E. Norton, engineer in immediate charge of Reconstruction Finance Corporation mining loans, is making an inspection trip to properties in Western States for which RFC money was advanced. He will return to Washington on March 1.

Oscar A. Glaeser, safety engineer for the California State Compensation Insurance Fund since leaving the employ of the United Verde Copper Company two years ago, has joined the staff of the United States Bureau of Mines station at Pittsburgh, Pa.

W. R. Storms has severed his connection as geologist with the Park City Consolidated Mines Company, of Park City, Utah, and is now with the safety division of the United States Bureau of Mines. He is stationed at present at Pittsburgh, Pa.

W. B. Maxwell, recently manager of Granby Consolidated, has been appointed manager of Beattie Gold Mines,

succeeding A. J. Keast, who has resigned to return to Broken Hill, Australia, where he will have charge of Zinc Corporation's operations.

C. E. Bartlett, formerly assistant superintendent of the Midvale flotation mill, of the United States Smelting, Refining & Mining Company and later assistant superintendent of the parting plant, has gone to Deming, N. M., to be mill superintendent for the Peru Mining Company.

Philip D. Wilson, vice-president of Pardners Mines Corporation, Chrysler Building, New York, sailed on Jan. 24 for London. He is going thence by air to Siam to visit the Pinyok Tin Mine, in which Pardners Mines is interested and which has lately gone into production. He expects to return to New York about the end of March.

Frederick H. Davis, of Bloomfield, N. J., who was connected with Balbach Smelting & Refining Company for some years prior to 1919, has now rejoined the staff of the Balbach company as construction engineer and metallurgist in charge of operations at the Balbach plant in Newark, N. J.

Major R. E. Franklin, consulting engineer, has completed his work in connection with the reorganization and equipment of the Klondike properties of the Yukon Consolidated Gold Corporation, at Dawson, Yukon Territory, Canada, and has returned to his offices in the Hobart Building, San Francisco.

Robert W. Steele, vice-president of Dominion Securities Corporation and director of a number of paper and textile companies, has been elected president of Asbestos Corporation, Ltd., to succeed the late Col. Robert F. Massie. Mr. Steele is retiring from his position with Dominion Securities to devote his efforts to affairs of the asbestos company.

Gardiner Edwards, formerly efficiency engineer at the Ahmeek mine, in Michigan, has left for Goldfield, Nev., where he has taken a position with Eastern Exploration, a subsidiary of Calumet & Hecla Consolidated. Surveys and sampling have been in progress over a large area on which long-term options are held by Eastern Exploration.

OBITUARY

M. W. Bacon, consulting engineer, of New York City, died on Jan. 4 last.

Ralph C. Maxwell, metallurgical engineer, died at San Antonio, Tex., on Jan. 14.

William J. Woodney, veteran Canadian prospector, died in Cobalt recently at the age of 82.

Captain M. D. Murray, mining man and a pioneer of the Southwest, died on Jan. 18 last at the age of 77.

Walter Worwill Riddell Jago, secretary of the Mine Managers Association of the Transvaal, died at Johannesburg on Nov. 23 last, at the age of 64.

C. A. Farlow, lessee of the Argyle and Elkhart properties near Chloride, Ariz., died Nov. 28. From 1924 to 1930, he was development engineer for Miami Copper, resigning to accept a position in the U.S.S.R.

Theodore F. Van Wagenen, an alumnus of Columbia School of Mines, class of 1870, author and metallurgist, long identified with mining in Colorado and adjacent states, and with Rhodesia and Mexico as well, died in Basin on Jan. 6 last in his 87th year.

Noah Timmins, for 36 years identified with the mining development of Quebec and Ontario, holding large interests in Hollinger and other Canadian mining properties, and for whom the mining town of Timmins, Ont., is named, died at Palm Beach, Fla., on Jan. 23, at the age of 68.

Edward Henry Hamilton, retired Canadian metallurgist, died recently at Montreal. He was 74 years of age. Mr. Hamilton was a prominent figure in mining and metallurgical circles, and during his active career held important positions in various parts of Canada and the United States.

Wallace Thompson, editor and author, since 1927 editor in chief of *Ingenieria Internacional,* and Washington correspondent on NRA affairs for the McGraw-Hill Publishing Company during the existence of that Government agency, died on Jan. 7, in New York City. He was 53 years old.

J. Marcellus Snow, 53, for many years associated with the Tintic Standard Mining Company, died recently at his home in Salt Lake City. Mr. Snow was born at St. George, Utah. An associate for 25 years of the late E. J. Raddatz, discoverer of the Tintic Standard mine, Mr. Snow is credited with having contributed much to the discovery of East Tintic orebodies.

Herman M. Forsnas, mine superintendent of Magma Copper, died on Jan. 13. Mr. Forsnas had been associated with Nevada Consolidated at Bingham, Ray Consolidated, and Inspiration, before joining the Magma staff in 1914. He was one of Magma's oldest employees in point of service and was active until within five days before his death.

James H. Hensley, assistant manager of Miami Copper Company, died at Miami, Ariz., on Jan. 13. Mr. Hensley was born in Socorro, N. M., 55 years ago, and was educated in the schools of Denver and graduated at the Colorado School of Mines, Golden. Following several years of experience in Alaska, he came to the Miami company in 1909, and after ten years of service in the engineering department was appointed mine superintendent, and in 1929 was advanced to assistant manager and held this position with distinction until the time of his death.

Fred R. Low, an international figure in journalism and engineering, died on Jan. 22 at his home in Passaic, N. J., where he had been critically ill for several years. He was 75 years old. A self-made man, whose schooling had stopped when he was fourteen, Mr. Low attained wide recognition as an engineer and a technical editor. At the time of his death he was editor emeritus of *Power,* following 42 years (1888-1930) as its chief editor. Mr. Low was a past president of the American Society of Mechanical Engineers, former Mayor of Passaic, Honorary Member of the British Institution of Mechanical Engineers, and Honorary Doctor of Engineering, Rensselaer Polytechnic Institute.

A LETTER

Flotation of Gold Ores

The Editor:

From experience I know that technical journals do not care to print the results of negative experiments, so I will not give my own with oxidized gold ores. Suffice it to say that the results have been far from encouraging, which does not mean that others may not find ways to overcome the difficulties. These ores have no trace of sulphides.

None of the experimental data I have been able to gather have dealt with a natural oxidized gold ore. Why, I am at a loss to discover. Leaver & Woolf (United States Bureau of Mines Report 3226) used a synthetic mixture of sea sand and ground pyrite. L. G. Lange (Technical Paper, American Cyanamid Company) experimented with a crude sulphide ore. The retreatment of Mother Lode tailings (United States Bureau of Mines Report 481) deals with sulphide tailings; another experimenter treats placer gold.

Looking to some of the authorities, we quote from A. F. Taggart's "Ore Dressing": "Low grade non-sulphide ores are not ordinarily suited to flotation because there is not enough metallic substance to stabilize a froth."

Gaudin, "Flotation," says: "It might well be thought that if gold occurs free in the native state, it should float as well as other native metals. However, gold is malleable and becomes flattened to thin pellets in course of grinding; grinding does not comminute the gold particles but simply flattens them. It is, therefore, very difficult to reduce gold to a flotation size." (Ball-mill grinding is likely to produce spirals of gold.)

The experiments recorded in technical literature have their use in giving the experimenter an idea of what to expect from various reagents, but these experiments might go beyond just mere recovery percentages and pave the way for preliminary concentration to reduce the capital expense for cyanide equipment, as at the McIntyre mill, Canada (*E.&M.J.*, Nov., 1933).

I am willing to send to any school of mines a quantity of truly oxidized gold ore, wherein a large percentage of the gold can be recovered by panning, if flotation and other experiments be made public for the benefit of those who have such ores but not the financial means to erect an expensive cyanide plant.

ALGERNON DEL MAR.

4524 Alpha St.,
Los Angeles, Calif.

(Technical journals are not averse to publishing negative results of experimentation if they establish facts of value to the industry. We welcome Mr. Del Mar's comments and hope that his offer will be accepted by schools of mines. Results of experimentation can be submitted to this journal for publication.—EDITOR.)

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

VOLUME of new business in major non-ferrous metals during January was on a smaller scale than in the preceding month, which producers attributed to several causes, including uncertainty over the Washington scene, a natural slowing down of automobile construction, resulting from the shift in the period for introducing new models, and a desire of many consumers to digest raw materials on hand until the prospects for another upturn in prices become more definite. More lead was sold during January than in December, but this condition did not obtain in either copper or zinc. Tin was in demand for March-April delivery toward the close of the month.

The *E.&M.J.* index of non-ferrous metal prices declined to 72.25 in January, owing chiefly to the weakness in silver. In December the index stood at 75.81, and a year ago at 70.43.

With the exception of silver, prices showed little net change. The New York quotation for foreign silver declined from 49.75c. per ounce to 44.75c. Silver producers hold to the view that the most recent decline here took place to bring the New York market in line with London. Except for a brief remark to the press by Secretary Morgenthau to the effect that "the silver situation is behaving pretty well," there was no official news on the revised buying program. The price paid for newly mined domestic silver continued at 77.57c.

Sales of copper in the domestic market during January totaled 33,000 tons, against 40,343 tons in December. Apparent consumption of copper in the United States during December was estimated at a little under 44,000 tons, which compares with 52,000 tons in November. January figures are not yet available. World stocks of refined copper at the end of 1934 and 1935, based on figures compiled by the Copper Institute, in short tons, were:

	1934	1935
United States	354,400	231,400
Elsewhere	232,800	253,900
Totals	587,200	485,300

The first two weeks of January were rather dull for producers of lead. Later in the month enough business was booked to bring the sales total close to the average of recent months.

Competition for business resulted in slight irregularity in prices for Prime Western zinc late in the month.

Quicksilver advanced $1 to $77 per flask. Antimony was quiet and one-half cent lower. Refined platinum was reduced to $35 per ounce.

United States Market

1936 Jan.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
2	9.025	8.375	48.250	4.50	4.35	4.85
3	9.025	8.325	47.675	4.50	4.35	4.85
4	9.025	8.300	47.500	4.50	4.35	4.85
6	9.025	8.325	47.000	4.50	4.35	4.85
7	9.025	8.275	47.000	4.50	4.35	4.85
8	9.025	8.250	47.125	4.50	4.35	4.85
9	9.025	8.300	47.125	4.50	4.35	4.85
10	9.025	8.300	47.125	4.50	4.35	4.85
11	9.025	8.300	48.000	4.50	4.35	4.85
13	9.025	8.350	47.875	4.50	4.35	4.85
14	9.025	8.350	47.750	4.50	4.35	4.85
15	9.025	8.350	47.625	4.50	4.35	4.85
16	9.025	8.300	47.600	4.50	4.35	4.85
17	9.025	8.300	47.375	4.50	4.35	4.85
18	9.025	8.300	47.300	4.50	4.35	4.85
20	9.025	8.275	46.875	4.50	4.35	4.85
21	9.025	8.275	46.860	4.50	4.35	4.85
22	9.025	8.350	46.175	4.50	4.35	4.85
23	9.025	8.425	46.000	4.50	4.35	4.85
24	9.025	8.500	46.300	4.50	4.35	4.85
25	9.025	8.475	46.300	4.50	4.35	4.85
27	9.025	8.475	46.250	4.50	4.35	4.85
28	9.025	8.475	46.375	4.50	4.35	4.80@4.85
29	9.025	8.475	48.000	4.50	4.35	4.80@4.85
30	9.025	8.450	48.125	4.50	4.35	4.85
31	9.025	8.425	48.500	4.50	4.35	4.85
Av. for month	9.025	8.358	47.234	4.50	4.35	4.848
			Averages for Week			
1	9.025	8.375	48.530	4.50	4.35	4.850
8	9.025	8.308	47.425	4.50	4.35	4.850
15	9.025	8.325	47.583	4.50	4.35	4.850
22	9.025	8.300	47.031	4.50	4.35	4.850
29	9.025	8.471	46.538	4.50	4.35	4.842
			Calendar Week Averages			
4	9.025	8.350	48.130	4.50	4.35	4.85
11	9.025	8.292	47.229	4.50	4.35	4.85
18	9.025	8.325	47.588	4.50	4.35	4.85
25	9.025	8.383	46.418	4.50	4.35	4.85

Silver, Gold, and Sterling Exchange New York and London

1936 Jan.	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
2	4.92750	4.91625	49.750	22.3750	141s 4 d	$35.00
3	4.92500	4.91375	49.750	21.5000	141s 2½d	35.00
			No	No		
4	4.92875	4.91750	Quotation	Quotation	141s 2½d	35.00
6	4.92750	4.91625	49.750	20.5000	141s 2 d	35.00
7	4.93000	4.91875	49.750	20.7500	141s ½d	35.00
8	4.93125	4.92000	49.750	20.8125	141s ¾d	35.00
9	4.94750	4.94000	49.750	20.5000	140s 11½d	35.00
10	4.94625	4.93875	49.750	20.5000	141s	35.00
			No	No		
11	4.97500	4.96750	Quotation	Quotation	140s 11 d	35.00
13	4.96750	4.96125	49.750	20.5000	140s 11 d	35.00
14	4.96000	4.95375	49.750	20.5000	140s 9 d	35.00
15	4.96500	4.95750	49.750	20.0625	140s 9½d	35.00
16	4.96000	4.95375	48.750	19.8750	140s 10 d	35.00
17	4.95500	4.94875	45.750	19.0000	140s 11 d	35.00
			No	No		
18	4.95250	4.94500	Quotation	Quotation	140s 10 d	35.00
20	4.94750	4.94000	44.750	19.1875	140s 10½d	35.00
				No	No	
21	4.94750	4.94000	44.750	Market	Market	35.00
22	4.95375	4.94750	44.750	19.9375	140s 9½d	35.00
23	4.96500	4.96000	44.750	20.0000	140s 9½d	35.00
24	4.99000	4.98750	44.750	19.7500	140s 10 d	35.00
			No	No		
25	5.00000	4.99500	Quotation	Quotation	140s 7½d	35.00
27	5.00250	4.99750	44.750	20.0000	140s 9 d	35.00
				No	No	
28	4.99375	4.98875	44.750	Market	Market	35.00
29	4.98750	4.98125	44.750	20.0000	140s 8 d	35.00
30	5.00000	4.99375	44.750	19.5625	140s 8 d	35.00
31	5.00375	4.99750	44.750	19.6875	140s 9 d	35.00
Av. for month	4.96115	.....	47.250	20.250	.....	35.00
			Averages for Week			
1	4.92925	.....	49.750	.....	.....	.....
8	4.92833	.....	49.750	.....	.....	.....
15	4.96021	.....	49.750	.....	.....	.....
22	4.95271	.....	45.750	.....	.....	.....
29	4.98979	.....	44.750	.....	.....	.....

Calendar week averages: New York Silver Jan. 4th, 49.750; 11th, 49.750; 18th, 48.750; 25th, 44.750.

The above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Standard					
Jan.	Spot	3M	Bid	Spot	3M	Spot	3M	Spot	3M
2	34.9375	35.3125	39.2500	217.7500	207.7500	15.5000	15.5625	14.2500	14.5625
3	34.6875	35.1250	38.7500	213.5000	205.2500	15.1875	15.3125	14.1875	14.4375
6	34.8125	35.1875	38.7500	212.0000	204.0000	15.4375	15.5625	14.3125	14.5625
7	34.4375	34.8750	38.5000	210.5000	201.8750	15.3750	15.5000	14.2500	14.5625
8	34.6875	35.1250	39.0000	211.5000	202.5000	15.3750	15.5000	14.5000	14.7500
9	34.5625	34.9375	38.5000	211.2500	202.2500	15.3125	15.4375	14.3125	14.5625
10	34.5625	34.9375	38.5000	210.5000	202.0000	15.3125	15.4375	14.3750	14.5625
13	34.5000	34.8750	38.5000	212.7500	203.5000	15.2500	15.3750	14.3125	14.5625
14	34.6875	35.1250	38.7500	213.1250	203.5000	15.0625	15.1250	14.3750	14.6250
15	34.5000	34.9375	38.5000	212.7500	203.5000	14.6875	14.8125	14.3125	14.5625
16	34.4375	34.8125	38.2500	212.7500	204.0000	14.4375	14.5625	14.1875	14.4375
17	34.6250	35.0000	38.5000	211.5000	203.3750	14.6875	14.8750	14.1875	14.4375
20	34.5000	34.8750	38.5000	209.5000	201.5000	14.8750	15.0000	14.3125	14.5625
21					No Market				
22	34.9375	35.3125	39.0000	207.0000	198.7500	15.1250	15.1875	14.2500	14.5625
23	35.0625	35.5000	39.2500	203.0000	196.5000	16.0625	16.0625	14.4375	14.7500
24	34.8750	35.3125	39.2500	202.5000	196.5000	15.8125	15.8750	14.7500	15.0000
27	34.9375	35.3125	39.2500	201.2500	194.7500	16.1250	16.2500	15.0625	15.1875
28					No Market				
29	34.8750	35.3125	39.0000	207.5000	198.7500	16.1250	16.2500	15.1875	15.3125
30	34.8125	35.2500	39.0000	206.0000	198.0000	16.2500	16.2500	15.1250	15.2500
31	34.6875	35.0625	38.7500	208.0000	198.2500	15.9375	15.9375	15.0625	15.1250
Av. for month	34.706	.....	38.788	209.731	.....	15.397	15.494	14.488	14.719

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(February 1, 1936)

Miscellaneous Metals

Aluminum, ingot, 99 plus per cent, lb	19@21c.
Antimony, domestic or Chinese (duty paid), lb	12.75c.
Bismuth, ton lots, lb	$1.00
Cadmium, lb	$1.05
Chromium, 97 per cent grade, lb	88c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (official quotation) troy oz	$35.00
Quicksilver, flask of 76 lb., 100 flasks or more	$77.00
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent. lb	$2.00
Silicon, minimum 97 per cent. spot, lb	16.50c.
Tellurium, lb	$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Ol. Range non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent. Joplin, Mo., ton	$47.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese, duty paid	$16.00@$16.25
Domestic Scheelite	$16.00@ .....
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$32.00

Metallic Compounds

Arsenious Oxide (arsenic) lb	3½c.
Cobalt Oxide, 70@71 per cent, lb	$1.29@$1.39
Copper Sulphate, 100 lb	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.24
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$30.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb	10c.
Ferromanganese, 78@82 per cent, gross ton	$75.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon. 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent. lb of W contained	$1.30@$1.40

Non-Metallic Minerals

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$500@ .....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47@ .....
Paper stock	$35@ .....
Cement stock	$23@ .....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a) $4.50@ $6.00
French, 56@59 per cent	(a) $5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$7.00@ $9.00
Delaware, No. 1	$14.00@ .....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$16.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@ .....
Dead-burned, f.o.b. Washington	$22.00@ .....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c
2x2 in.	30@50c
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@ .....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@ .....
200 mesh, cream colored	$25.00@ ...

(a) Nominal

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$20 00
Basic	$19.00
No. 2 Foundry	$19.50
Steel, base prices, Pittsburgh:	
Billets, gross ton	$20.00
Structural shapes, 100 lb	$1.80
Bars, 100 lb	$1.85

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1935	1936	1935	1936	1935	1936
January	54.418	47.250	24.584	20.250	489.207	496.115
February	54.602	.....	24.818	.....	487.278	.....
March	59.048	.....	27.380	.....	477.635	.....
April	67.788	.....	30.986	.....	483.596	.....
May	74.356	.....	33.865	.....	488.587	.....
June	71.940	.....	32.346	.....	493.245	.....
July	68.216	.....	30.500	.....	495.558	.....
August	66.366	.....	29.476	.....	496.815	.....
September	65.375	.....	29.255	.....	492.917	.....
October	65.375	.....	29.368	.....	490.577	.....
November	65.375	.....	29.284	.....	492.277	.....
December	58.420	.....	25.563	.....	492.715	.....
Year	64.273	.....	28.952	.....	490.034	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery				London Spot			
	Electrolytic						(a)	
	Domestic		Export		Standard		Electrolytic	
	1935	1936	1935	1936	1935	1936	1935	1936
January	8.775	9.025	6.583	8.358	28.077	34.706	31.261	38.788
February	8.775	.....	6.341	.....	27.175	.....	30.244	.....
March	8.775	.....	6.526	.....	28.518	.....	31.607	.....
April	8.775	.....	7.328	.....	31.231	.....	34.763	.....
May	8.775	.....	7.794	.....	33.344	.....	36.733	.....
June	8.634	.....	7.307	.....	30.799	.....	34.039	.....
July	7.775	.....	7.350	.....	31.024	.....	34.261	.....
August	7.979	.....	7.738	.....	32.646	.....	35.976	.....
September	8.504	.....	8.146	.....	34.036	.....	37.952	.....
October	8.967	.....	8.514	.....	35.226	.....	39.609	.....
November	9.025	.....	8.414	.....	35.229	.....	39.396	.....
December	9.025	.....	8.414	.....	35.097	.....	39.313	.....
Year	8.649	.....	7.538	.....	31.867	.....	35.430	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1935	1936	1935	1936	1935 Spot	1935 3 Mos.	1936 Spot	1936 3 Mos.
January	3.692	4.500	3.542	4.350	10.321	10.514	15.397	15.494
February	3.528	.....	3.378	.....	10.216	10.413	.....	.....
March	3.579	.....	3.429	.....	11.012	11.188	.....	.....
April	3.692	.....	3.542	.....	12.231	12.459	.....	.....
May	3.962	.....	3.812	.....	13.861	13.940	.....	.....
June	4.020	.....	3.870	.....	13.776	13.806	.....	.....
July	4.123	.....	3.973	.....	14.451	14.511	.....	.....
August	4.254	.....	4.104	.....	15.774	15.792	.....	.....
September	4.413	.....	4.263	.....	16.262	16.315	.....	.....
October	4.512	.....	4.362	.....	18.209	18.209	.....	.....
November	4.500	.....	4.350	.....	17.938	17.935	.....	.....
December	4.500	.....	4.350	.....	16.803	16.828	.....	.....
Year	4.065	.....	3.915	.....	14.238	14.326	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1935	1936	1935	1936
January	50.916	47.234	231.193	209.731
February	50.063	.....	227.381	.....
March	46.962	.....	215.726	.....
April	50.154	.....	223.513	.....
May	51.138	.....	227.602	.....
June	51.108	.....	227.586	.....
July	52.297	.....	232.397	.....
August	50.463	.....	222.935	.....
September	49.126	.....	223.929	.....
October	51.160	.....	226.891	.....
November	51.864	.....	226.452	.....
December	49.794	.....	220.075	.....
Year	50.420	.....	225.473	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1935	1936	1935 Spot	1935 3 Mos.	1936 Spot	1936 3 Mos.
January	3.730	4.848	11.994	12.207	14.488	14.719
February	3.714	.....	11.819	12.000	.....	.....
March	3.894	.....	12.095	12.250	.....	.....
April	4.030	.....	12.891	13.128	.....	.....
May	4.220	.....	14.534	14.685	.....	.....
June	4.299	.....	13.734	13.898	.....	.....
July	4.325	.....	14.065	14.185	.....	.....
August	4.535	.....	14.714	14.938	.....	.....
September	4.669	.....	15.414	15.616	.....	.....
October	4.825	.....	16.440	16.674	.....	.....
November	4.850	.....	16.193	16.372	.....	.....
December	4.850	.....	15.091	15.278	.....	.....
Year	4.328	.....	14.082	14.269	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1935	1936	1935	1936
January	55.000	105.000	20.000	20.000
February	55.000	.....	20.000	.....
March	58.462	.....	20.000	.....
April	65.000	.....	20.000	.....
May	65.000	.....	20.000	.....
June	65.000	.....	20.000	.....
July	65.000	.....	20.000	.....
August	70.000	.....	20.000	.....
September	75.625	.....	20.000	.....
October	85.000	.....	20.000	.....
November	85.000	.....	20.000	.....
December	101.800	.....	20.000	.....
Year	70.491	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1935	1936	1935	1936	1935	1936
January	14.111	12.736	72.760	76.769	34.000	30.885
February	14.250	.....	72.500	.....	34.000	.....
March	14.250	.....	72.500	.....	32.846	.....
April	14.029	.....	72.500	.....	32.000	.....
May	12.712	.....	72.135	.....	32.000	.....
June	12.500	.....	71.460	.....	32.000	.....
July	12.500	.....	70.538	.....	32.000	.....
August	12.500	.....	69.000	.....	31.333	.....
September	13.177	.....	69.208	.....	35.000	.....
October	15.322	.....	71.750	.....	37.615	.....
November	14.217	.....	74.348	.....	38.000	.....
December	13.820	.....	75.200	.....	38.000	.....
Year	13.616	.....	71.992	.....	34.150	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1935	1936	1935	1936	1935	1936
January	19.00	20.00	18.00	19.00	18.50	19.50
February	19.00	.....	18.00	.....	18.50	.....
March	19.00	.....	18.00	.....	18.50	.....
April	19.00	.....	18.00	.....	18.50	.....
May	19.00	.....	18.00	.....	18.50	.....
June	19.00	.....	18.00	.....	18.50	.....
July	19.00	.....	18.00	.....	18.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	20.00	.....	19.00	.....	19.50	.....
December	20.00	.....	19.00	.....	19.50	.....
Year	19.167	.....	18.167	.....	18.667	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.